Building Information Modeling with Autodesk Revit Building

Student Workbook

Autodesk®

Contents

Introduction

This student workbook contains a set of exercises that clarify in a practical way the concepts explained in the “Building Information Modeling with Autodesk Revit Building Lecture Notes” by Simon Greenwold.

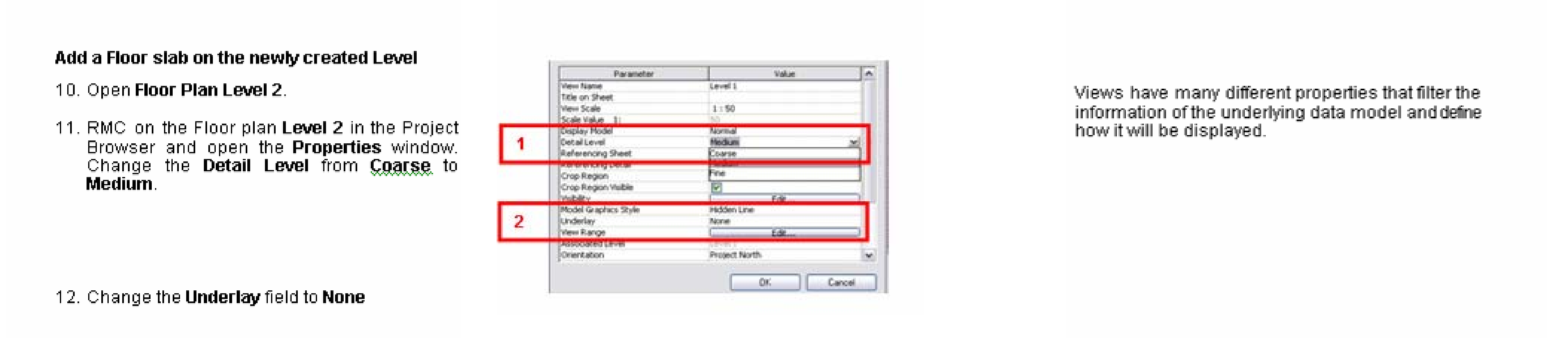
The exercises cover the basic principles of the Autodesk® Revit® Building technology and the building information modeling (BIM) approach. For more training information, see the official Autodesk Revit Building training manuals and the tutorials available from the help menu. This workbook explains the different functionalities through various exercises, but the emphasis is on the workflow rather than on the tools themselves.

The difficulty of the exercises increases as you proceed through the units, so it is recommended that you do them in sequence. Most units are independent and can be done starting with the provided file, named Unit () – Start. Files with the completed exercises are included in the data set folder and can be used to check your work.

The workbook is structured in a three-column format (see image below):

- The first column contains an explanation of all steps necessary to complete an exercise.
- The middle column contains the images that clarify visually the tasks to accomplish.
- The third column contains notes on the features and tools that are being used and a few helpful tips.

Practical Instructions to complete the exercises	Images	Notes on the features and on the software in general

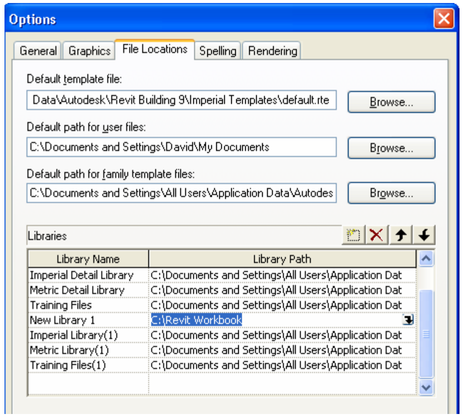


We have prepared the following data for you:

- Workbook (this document)
- Workbook data sets (placed in a folder, that contains all necessary files, families, and the template prepared for your use)

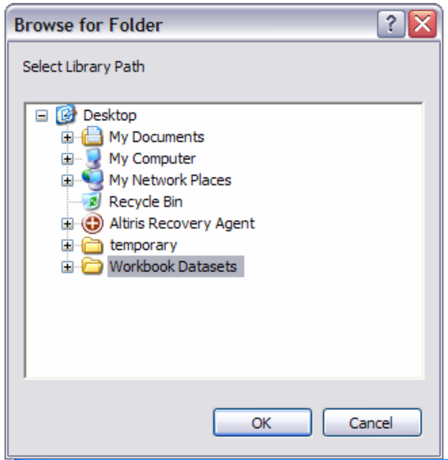
Before starting the exercises, change the following settings to simplify use of this workbook and provide faster access to the data sets:

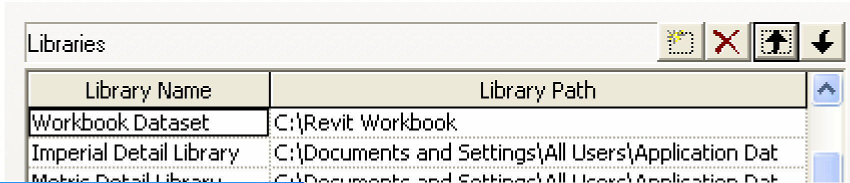
1. **Copy** the provided **Workbook Data Sets** folder onto your desktop.
2. **Open** Autodesk Revit Building.
3. From the Settings menu, choose Options.
4. Click the **File Locations** tab.



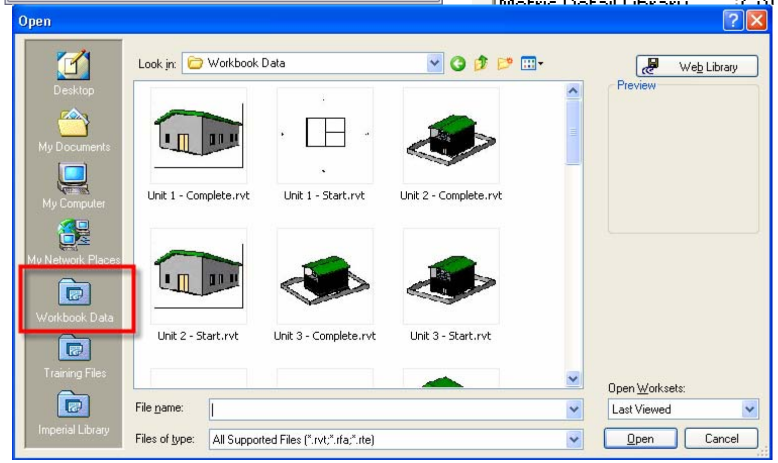
5. Click the **Add Library** button. 
6. Rename the newly created **New Library 1** to **Workbook Data Sets**. Click in the blank **Library Path** field next to it, and then click the Flash icon at the far right of the row. 

7. **Browse** to the path where you saved the data sets and click **OK.**
8. Click the Workbook Data Sets field, and using the upper flash sign  move it up to the first row.





You have just created a shortcut to the *Workbook* data folder so that each time you go to the **File** menu to **Open** or **Save,** you see the folder in the browse window on the left so you can access it quickly.



Note: Exercises for some lecture note units are not available here, and in some cases they have been grouped into a single exercise. The reason lies in the workflow approach that does not meet specific feature training requirements. For more information, see the Autodesk Official Training Courseware and the help file.

We hope you enjoy learning the principles of Autodesk Revit Building and the BIM approach.

Have fun!

Unit 1

Theory: CAD Versus BIM

Autodesk Revit Building: Introduction, Interface, and Sketching

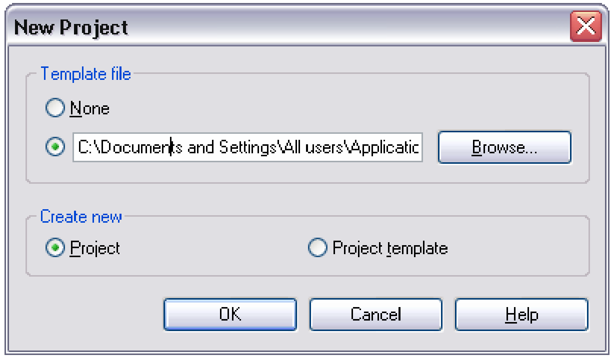
Exercise 1

In this first unit you start a new project using a template.

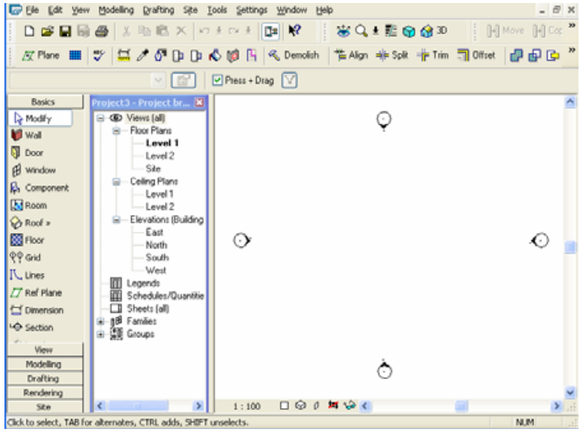
Templates are prepared drawing files that contain data according to office or project standards, helping to ensure that all team members working on the same project are using the same objects and standards. You can create these templates on your own, according to your office or project requirements.

Create a New Project Using the Provided Template

1. From the **File** menu, choose **New>Project.**
2. Click the **Browse** button, and then click the Revit Workbook library shortcut icon.



3. Select the **Workbook Metric Template.rte** template.



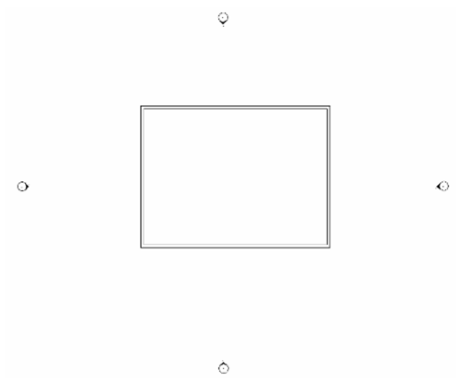
A new project file is created.

Each of these templates has unique families, views, and possibly sheets already loaded for you to work with.

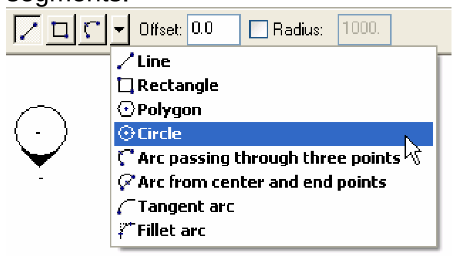
The path to the default template used for all projects is set on the Settings menu: Options>File Locations>Default Template file. This determines which template is used when you click the New Project icon on the toolbar.

Add Walls

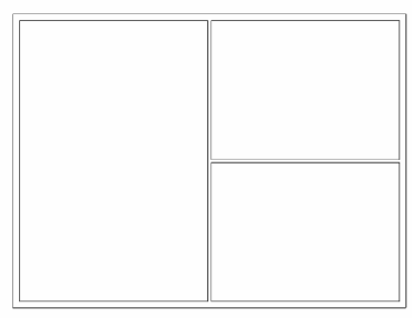
4. On the **Basics** Design Bar on the left of your screen, click the **Wall** tool and draw four walls. Accept all the default values. The rectangle should be about **12 x 10 m**.



After you select the Wall tool, the Options Bar displays the different options for drawing the wall segments.



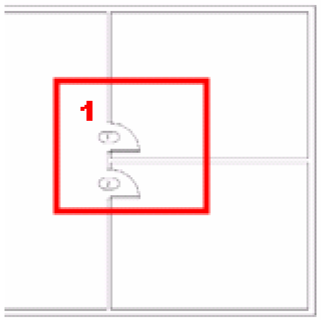
5. Without exiting the Wall command, change the wall type on the Options Bar to **Interior Blockwork 100** and draw two interior walls, as shown in the image.



Select the rectangular shape to draw the external walls, and then switch to the linear tool to draw the interior walls.

Add Doors and Windows

6. On the **Basics** Design Bar, click **Door** and place two doors **M_Single Flush 0864 x 2134 mm,** as shown in the image.

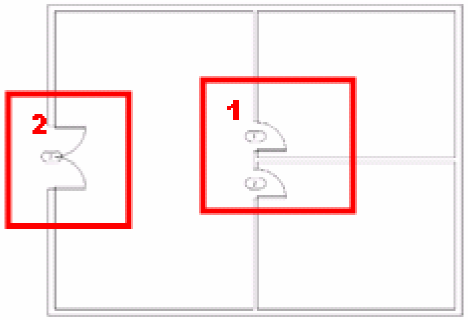


As you add these two doors, press the spacebar before you select a point to flip the swing before the door is placed.

7. With the Door tool still active, click the **Load** button on the Options Bar.

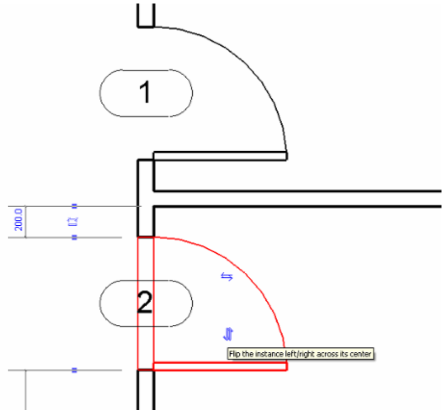
Many other door types are installed with the software but not available in the general template you started with. When you load from library, you are bringing in a family of doors and all its types.

8. Browse to the *Doors* folder, select the **M_Double Flush** door type, and click Open.
9. Change the door type on the Options Bar to Double-Flush: and position a door on the left wall, as shown in the image



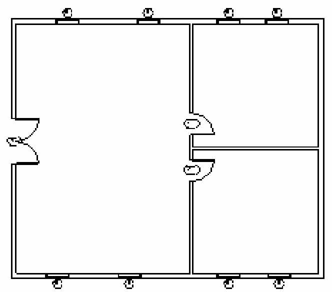
10. Press the **Esc** key twice to exit the command.

11. To change the swing direction, select the single flush door on the bottom vertical wall and click the vertical arrows that appear next to it.



The horizontal arrows mirror the door along the wall it is positioned on. Both vertical and horizontal arrow symbols appear in doors, windows, furniture components, and in all families that can be mirrored or reversed without changing their geometry or function.

12. On the **Basics** Design Bar, click **Windows** and select: **M_Fixed 0915 x 1220mm** and position some windows on the exterior walls.
13. Right-click and choose Cancel twice to exit the command.



Windows and doors are tagged automatically if **Tag on Placement** is selected on the Options Bar. To avoid automatic tagging, clear the option.

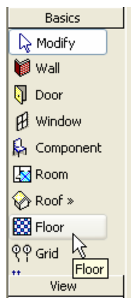
The tags that appear when placing the components are set on the Settings menu: Annotations>Loaded Tags.

To end a command in Revit Building, you can either press Esc two times, or right-click and choose Cancel two times.

Alternatively, you can select the next tool you want to use. Select the modify tool from the top of the Design Bar. Type MD on the keyboard to end most commands and return to the basic cursor state.

Add a Floor

14. On the **Basics** Design Bar, click **Floor**.

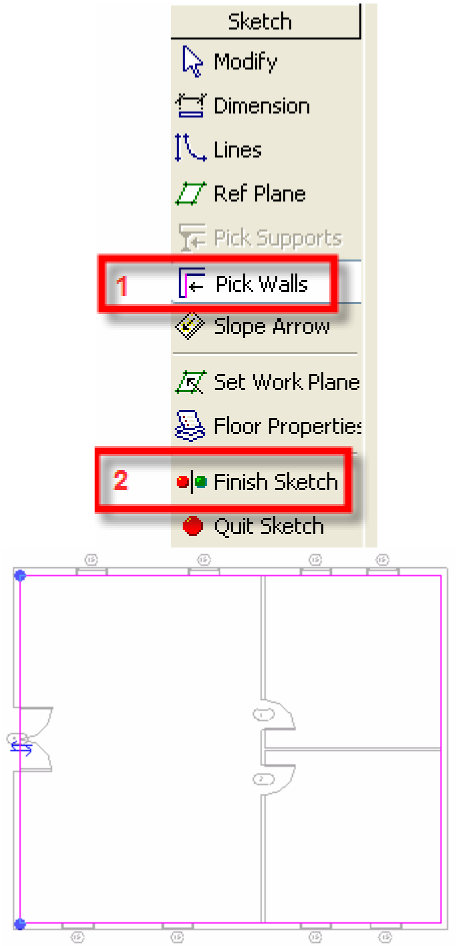


Sketch mode is activated when you are designing specific sketch-based components or geometry. The available options vary depending on the component you are designing.

15. You are now in **sketch mode,** and the Design Bar has changed. The default method for creating floors is by selecting existing walls (**Pick Walls**).

16. Highlight (place the cursor over it without clicking) one of the exterior walls and press the **Tab** key to highlight all four walls. Click with the left mouse button to select the highlighted walls as the floor boundary. Make sure you click the interior side of the walls.

17. Click **Finish Sketch** on the Design Bar to accept the floor sketch.



You can re-enter sketch mode any time after designing the component by selecting the component and clicking the Edit button on the Options Bar.

You can draw the desired shape of your object (floor in this case) using the Lines tool, but often it is much faster and easier to accept the default proposed mode. The Pick Walls function automatically recognizes the boundary of the connected walls and generates a closed loop of lines that represents the shape of the floor.

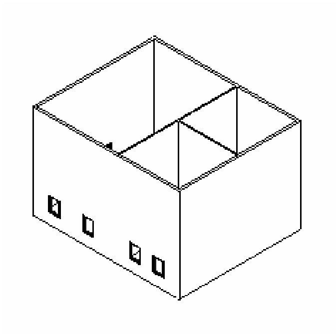
When you use Pick Walls to define your sketch, Revit Building snaps either to the exterior/interior faces of the wall or to its structural core layer, as set on the Options Bar.

This method is used frequently in Autodesk Revit Building. By holding your cursor over the object, pressing the Tab key, and then clicking, you can select connected chains of walls or lines.

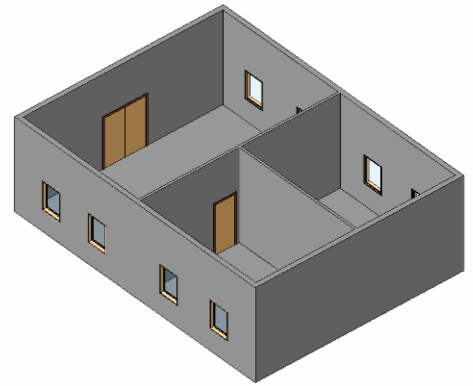
This screen capture is not from the project but illustrates the nature of the highlights on the screen.

The side of the wall your cursor is on when you select a wall determines which side of the wall the sketch line is placed on.

18. Open a **3D** view by clicking the 3D view icon on the toolbar.



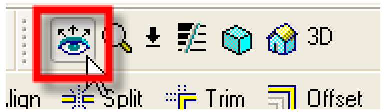
19. Press the keys **SD** (in sequence) to activate a shaded view *or* **right-click** the view and choose **View Properties**. In the Properties dialog box, change the **Model Graphics Style** to **Shading w/Edges:**



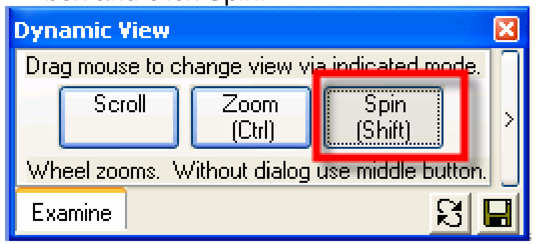
You can customize keyboard shortcuts by editing the *keyboardshortcuts.txt* file in the program folder.

You can rotate the model by

- Pressing the Shift key and the middle button of the mouse at the same time, or
- Clicking the icon on the view toolbar



To select spin mode, open the View dialog box and click Spin:

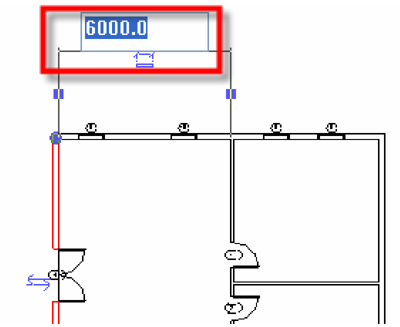


You can also change to Shading with Edges by using the View toolbar at the lower left of the drawing window.

Modify the Position of the Components

20. From the Project Browser, open Floor Plans Level 1 again by double-clicking **Floor Plans>Level 1**. Select the left exterior wall. A temporary dimension appears. Click the dimension text, and type **6000** to change the room width to 6 meters.

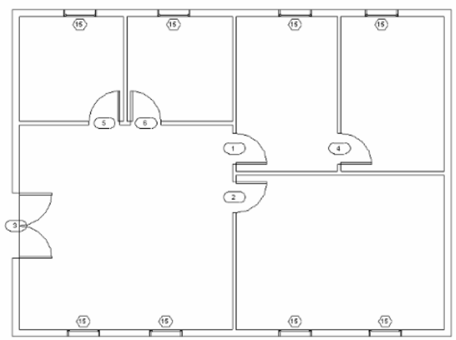
21. Repeat with the right exterior wall to change the width of the two rooms to 6 meters.



The units in Autodesk Revit Building are real-world units: you can set them to metric or imperial. You can access the dialog box for setting units by choosing Units from the Settings menu. You can also work in millimeters, centimeters, or meters, set in the same menu.

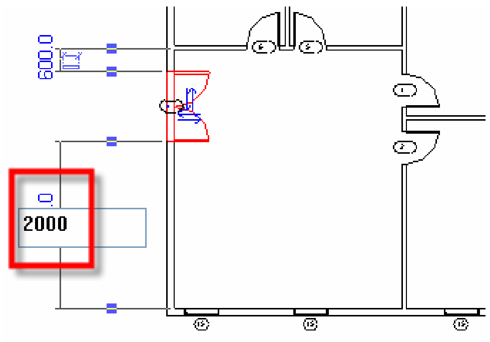
Notice that you have just defined a new position of the wall, but all other components adjusted accordingly.

22. Add walls and doors to create a few more rooms, always using the image as a guideline.



By right-clicking a component, you can use the **Place** function, which activates insertion mode for the desired component. This command automatically inserts an object of the same type as the one selected.

23. Select the double entrance door and change its position by changing the value of the lower temporary dimension: Type **2000** in the dimension text.



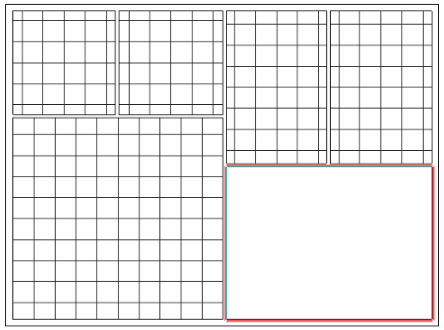
Temporary dimensions appear whenever you select a component. Edit these dimensions on the fly by clicking the text and typing the desired value.

Transform these dimensions into permanent dimensions by clicking the icon that appears below the dimension line.

Add Ceilings

24. In the **Project Browser**, double-click **Ceiling Plans>Level 1**.

25. On the **Modeling Design Bar**, click **Ceiling**. On the Options Bar, click **Compound Ceiling: 600 x 600mm grid**. Click once inside each of the rooms to automatically generate the ceilings.



Ceilings are also sketch based. The Autogenerate tool is helpful, but if you need to change the shape, you must select the ceiling and select Edit on the Options Bar.

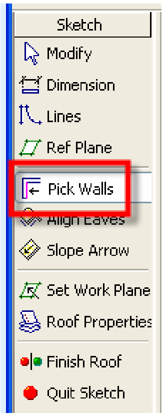
Hold and Tab Key

Sometimes selecting objects that are co-linear with other objects can be difficult. Hold your cursor over the edge of a ceiling (which is also the same location as a wall). Press the Tab key a couple of times to cycle through the objects that are at the cursor location. Watch the status bar at the lower-left corner of the screen.

Add a Roof

26. From the **Project Browser**, open **Floor Plans>Level 2**. On the **Modeling Design Bar**, click **Roof>By Footprint**.

27. You are in sketch mode. The default sketch mode is **Pick Walls**. On the Options Bar type **500** in the **Overhang** box, and make sure that **Defines Slope** is selected.

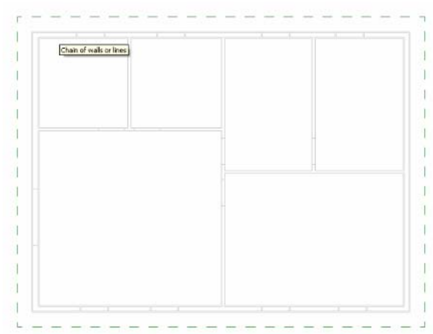


Roofs can be created by footprint or by extrusion. This exercise walks you through creating a roof by extrusion.

If the **Pick Walls** option is selected, the roof boundary follows the wall's position, and any further changes to the wall location are automatically propagated on the roof shape.

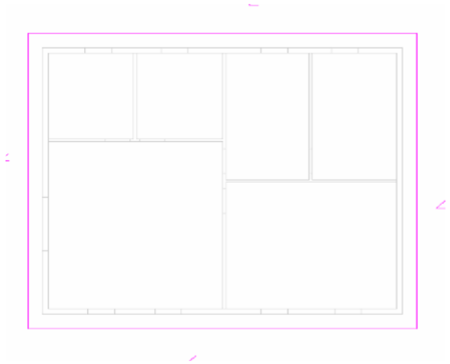
Pick Walls is equivalent to assigning a constraint to maintain design intent or structural sense.

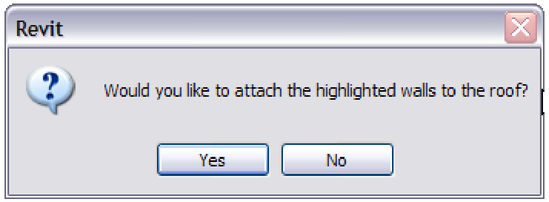
28. Highlight any exterior wall and press Tab to highlight all four. Click to create the roof footprint. When clicking, make sure your cursor is positioned on the exterior side of the walls or the overhang will be on the wrong side.



Tab selecting is a convenient way to select chains of components with a one-click operation. It is widely used in sketch mode.

29. On the Design Bar, click **Finish Roof**. A dialog box asks if you want to attach the highlighted walls to the roof. Click **Yes.**

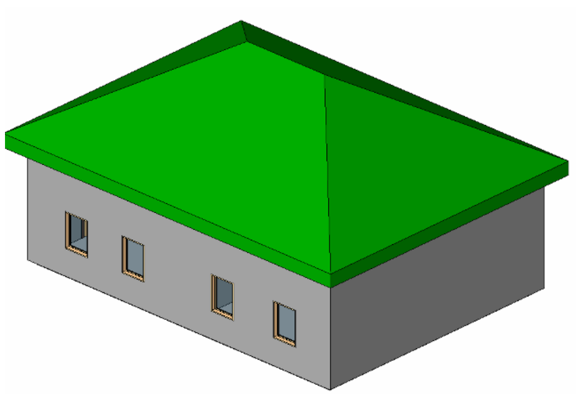




By clicking Yes, you are attaching the walls to the roof and thus defining an explicit relationship: if the roof changes height, the attached walls follow accordingly.

30. Open the **3D view** by clicking the 3D Icon to see the roof.

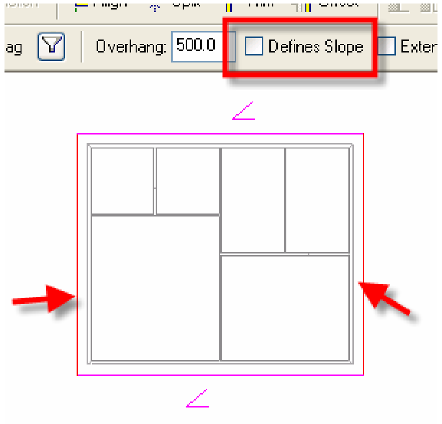
31. Go back to Floor Plan **Level 2**.



The 3D view category is automatically created once a 3D view is opened. You can customize view grouping so the Project Browser can display the view groups in many different ways.

32. Select the roof. On the **Options Bar**, click **Edit**.

33. Open Floor Plan Level 2. Select the left and right roof footprint lines. On the Options Bar, clear **Defines Slope**.

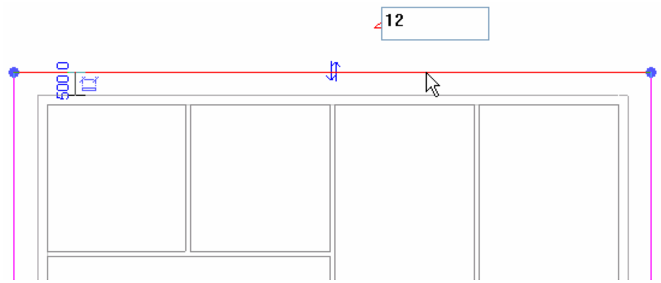


Autodesk Revit Building manages the slopes by automatically adjusting most geometrical data. If the eaves are not correct, use the Align Eaves tool to correct the problem.

To select more than a single item, hold down the Ctrl key as you select the objects.

Hold down the Shift key to remove objects from an existing selection set.

34. Select the top magenta line. Text displaying an angle value appears. Click the blue text and change the value to **12**. Repeat for the bottom line. Click **Finish Roof**.



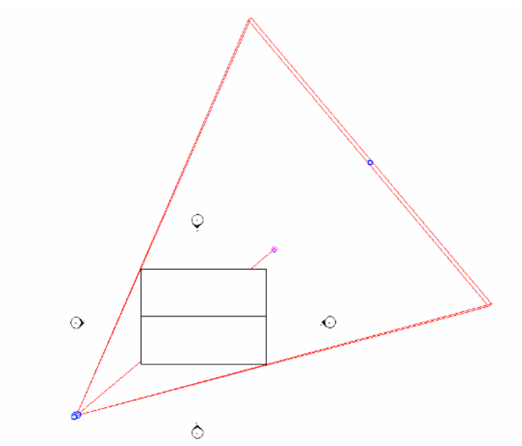
Sketch lines are displayed in magenta, which you can change to any other color: Settings>Line Styles>Lines(Sketch).

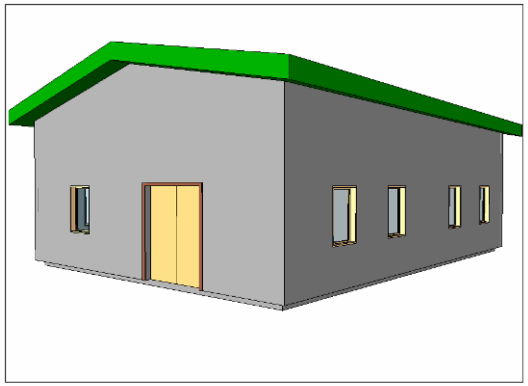
Change the value of the roof slope by selecting the slope defining line and opening its Properties dialog box, where you find the angle parameter.

Add a Camera (Perspective View)

35. Open **Floor Plan: Site**. Go to **View Design Bar** and select the **Camera** tool.

36. Select a point at the lower left to place the camera (see image). Select a point at the upper right to establish the direction the camera is pointing.





37. Once you have placed a camera, a 3D view displays the building (press **SD** to shade the view).

The camera creates a perspective view that is automatically placed under the 3D group in the Project Browser.

An easy way to reposition your camera directly in perspective view is by opening the Dynamically Modify View dialog box and applying the different options available for navigating in the 3D workspace.

Note that you can change or modify elements directly in 3D perspective views only by selecting the component and opening its Properties dialog box.

Once the camera view is generated, the camera itself is no longer displayed in plan views or sections/elevations. To display it, right-click the 3D perspective view in the Project Browser and choose Show Camera from the context-sensitive menu.

Unit 2

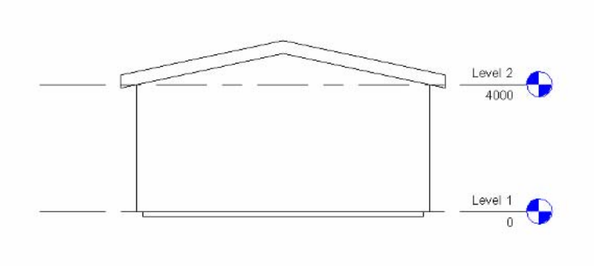
Theory: Objects

Autodesk Revit Building: Walls, Floors, and Ceilings

In this unit you cover wall, floor, and roof basics.

Add a New Level

1. Open **Elevation East.**

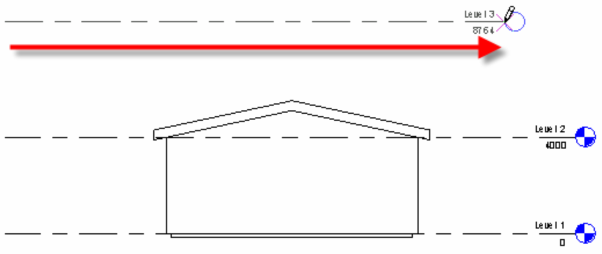


Autodesk Revit Building allows editing and creation of most components in all available views.

2. Go to the **Basics Design Bar** and select **Level**.

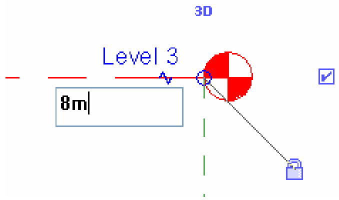
Levels are managed as any other entity.

3. Draw a level above Level 2 by drawing a horizontal line from left to right.



Note how Autodesk Revit Building helps you snap to the beginning and end of the other level lines.

4. Click the elevation text of the level mark, and type **8m**.

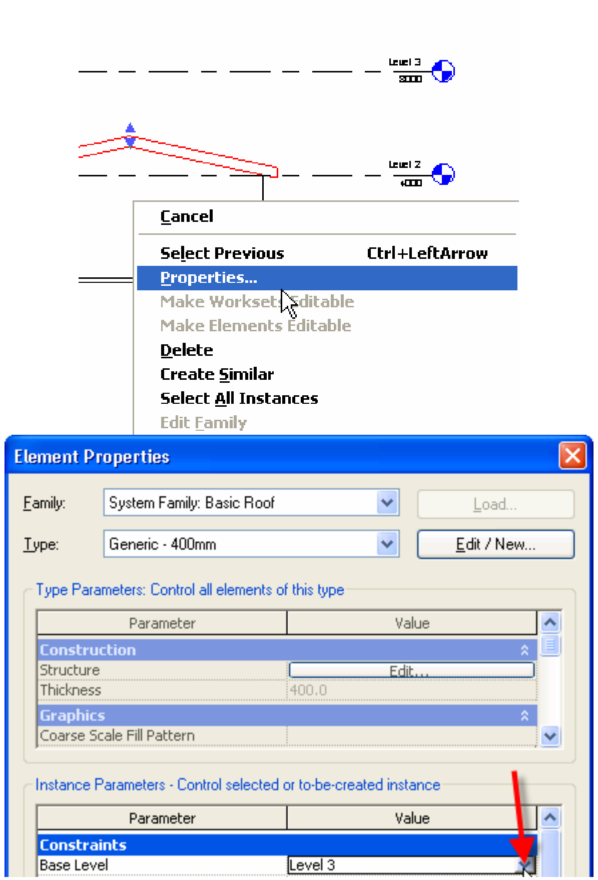


Some annotations allow direct editing of their properties (in this case: level height).

Revit Building automatically recognizes the different units used for editing if the unit suffix is added after the value.

Modify the Roof Position

5. Select the roof. **Right-click** and choose **Properties**.



6. Change the Roof **Base Level** to **Level 3**.

Change Wall Type

7. Open the **3D** view.
8. Select the four exterior walls at once (hold your cursor over one wall and press the Tab key). On the **Options Bar,** change the wall type to **Exterior – Brick on Mtl. Stud.**

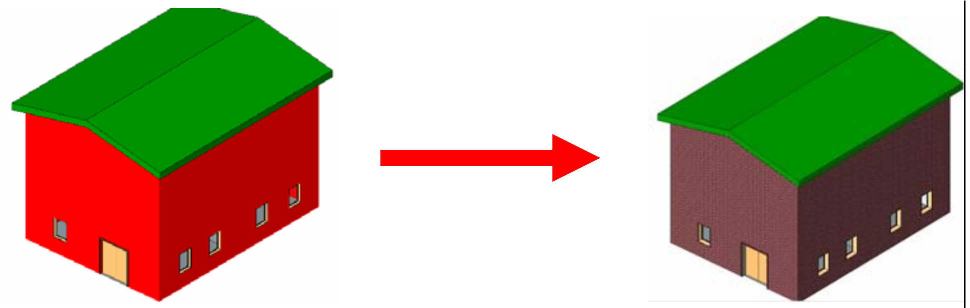
Levels are managed as any other entity.

Levels are a data element in Revit Building. Although they look like a standard annotation, they are the basis for vertical control for most components in the building model.

Change component constraints at any time during the design process.

The template contains many different wall types: walls, roofs, floors, ceilings, stairs, and railings are system families and cannot be loaded from an external file except by using the Transfer Project Standards command on the File menu.

Note that you must have at least two projects open in the same session for the tool to be available.



9. Zoom in the **3D** view to see the different finishes and material of the wall type.

Add a Floor Slab on Level 2

10. Open **Floor Plan Level 2**.

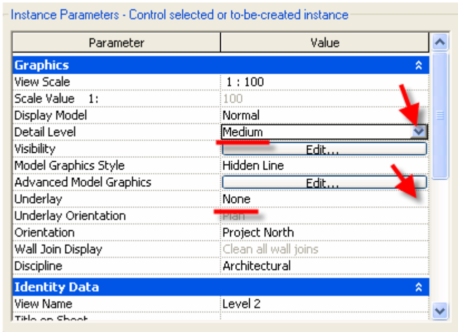
11. **Right-click** the Floor plan **Level 2** in the Project Browser and choose **Properties**. In the Properties dialog box, change the **Detail Level** from **Coarse** to **Medium**.

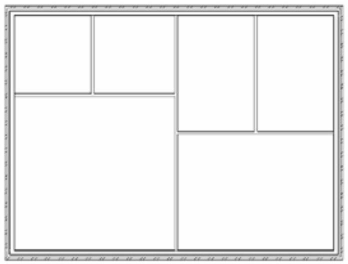
12. Change the **Underlay** field to **None.**

13. On the **Basics Design Bar**, select **Floor**. You are in sketch mode. Hold your cursor over one exterior wall, and press Tab. Click to select the four exterior walls.

14. On the Design Bar, click **Finish Sketch**.

15. Click **Yes** when the dialog box appears:





Views have many different properties that filter the information of the underlying data model and define how it is displayed.

When clicking the wall-defining line for the floor slab, make sure that

- The option Extend to Core is flagged on the Options Bar.

- The green lines that appear while highlighting the walls are in the middle of the wall (or slightly off center). This is the exterior face of the core of the wall. Alternatively, if the cursor is inside the building, to the line between the gypsum finish and the stud.

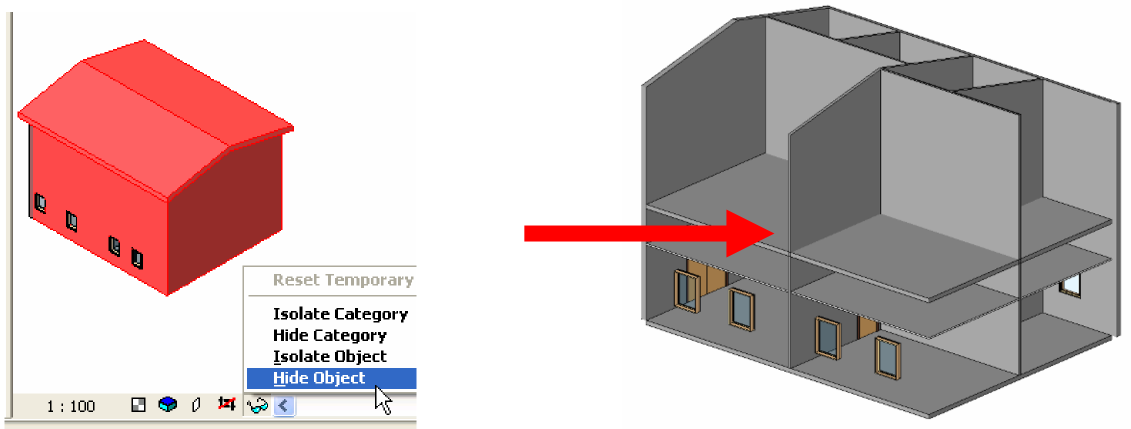
This option correctly cleans up the intersections among walls and the floor.

Constrain Walls to a Different Height

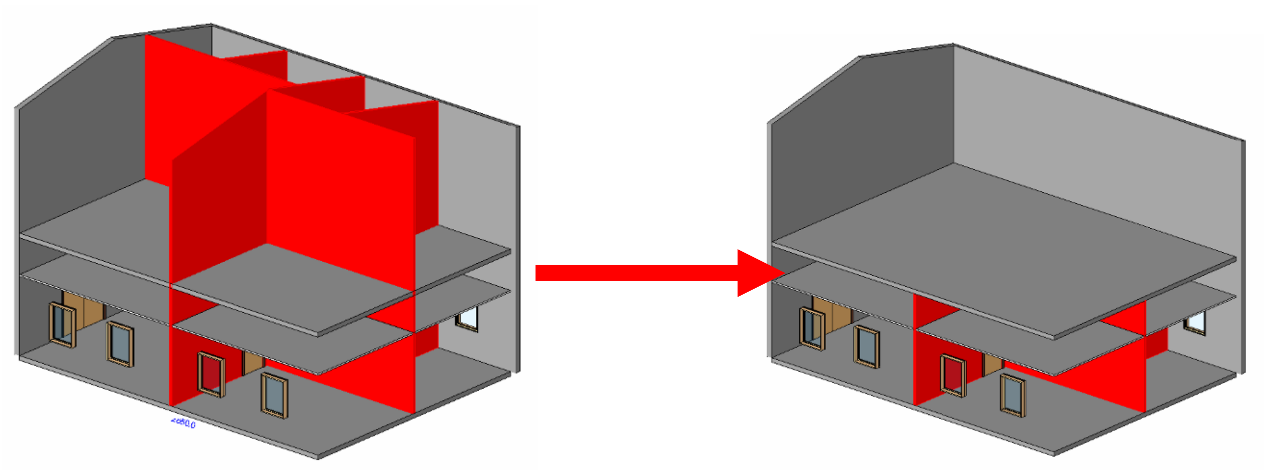
16. Open the **3D view**. Select the two visible exterior walls and the roof, and then click the **Hide/Isolate** icon on the View toolbar.

Hide/Isolate is a view-specific tool that is useful when working in a 3D view displaying a lot of data.

When the tool is active and a component is hidden or isolated, the icon on the View toolbar changes color to indicate that the view contains hidden data.

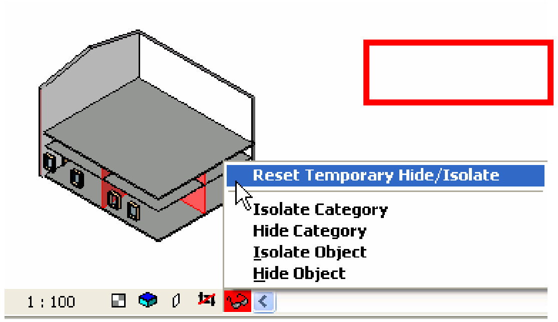


17. Select one interior wall. Right-click and choose Select All Instances. On the Options Bar, click **Attach**. Click the floor located on Level 2. You might get a warning dialog box. Ignore it.

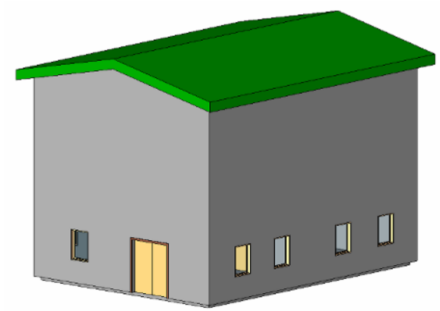


An explicit relationship between the interior walls and the slab above is established.

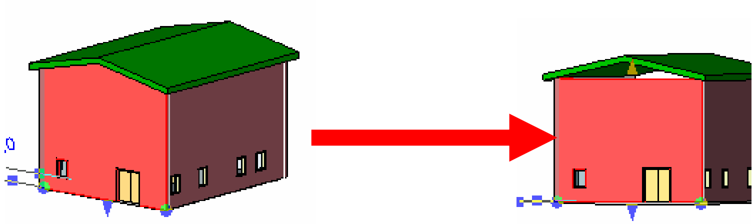
18. Click the **Hide/Isolate icon,** and on the View toolbar click **Reset Temporary Hide/Isolate**. Close the dialog box.



19. Rotate the 3D view, as shown in image.

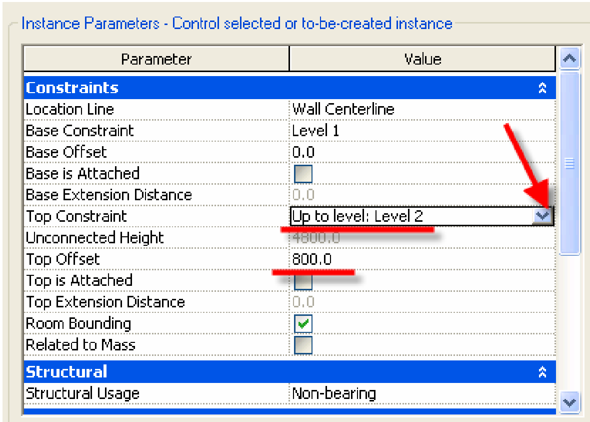


20. Select the front wall (containing the double door). On the Options Bar, click **Detach**, and then select the roof.

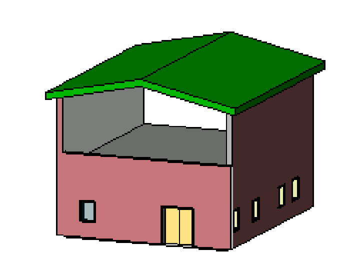


You can remove explicit relationships at any time.

21. Right-click the wall and choose **Properties**.



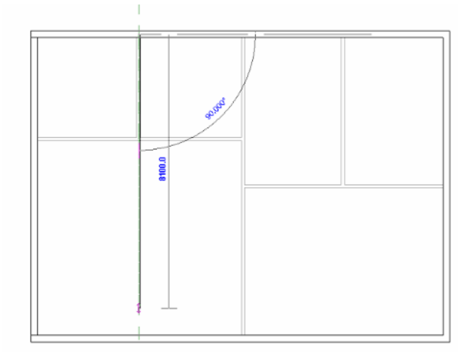
22. Change the **Top** constraint value from **Unconnected** to **Up to Level: Level 2** and the **Top** offset field to **800**.



Add a Curtain Wall and Modify Its Properties

23. Open Floor Plan **Level 2**. On the **Basics Design Bar**, click **Wall** and change the wall type on the Options Bar to **Curtain Wall: Exterior Glazing.** Before you start drawing, set the height to Level 3 on the Options Bar.

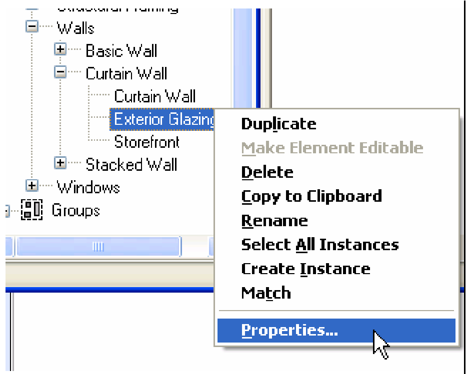
24. Draw a vertical wall, as shown in the image.



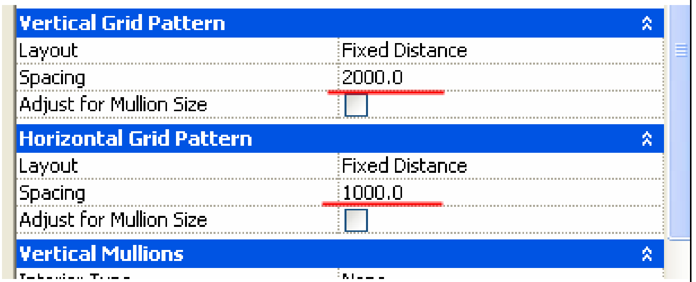
Curtain walls are considered as wall families. Most of the Instance parameters are the same as for the basic wall families, but the Type parameters are completely different.

25. Open the **3D view**.

26. From the **Project Browser**, click **Families>Walls>Curtain Wall** and right-click **Exterior Glazing**. Choose **Properties.**



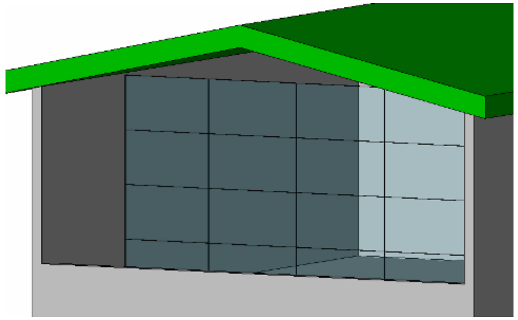
27. Change the pattern to the spacing as shown. Click **OK** to close the dialog box and see the changes in the model.



28. Select the curtain wall, and on the Options Bar click **Attach**, and then select the roof.

Add a Section

There are many different ways to access a family's Properties dialog box.



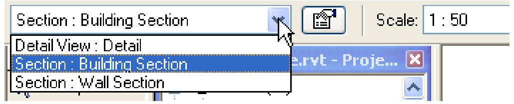
The pattern layout properties refer to the curtain gridlines.

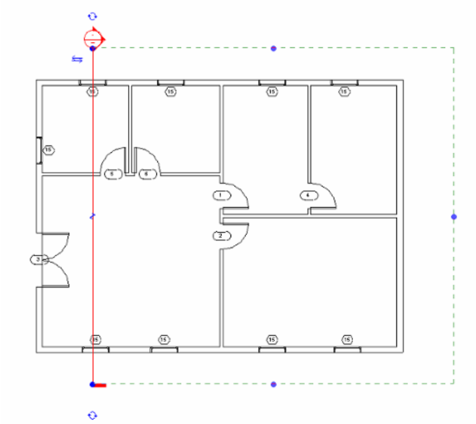
The available options allow for flexible editing.

This Curtain wall type contains only the grid divisions. Mullions must be placed after positioning the curtain wall.

To add mullions, on the Modeling Design Bar, click Mullion and click any curtain grid.

29. Open **Level 1,** and on the Design Bar click **Section.**
30. On the Options Bar, Set Type to **Section : Building Section.**
31. Draw a building section, as shown in image.





Like a level, creating a building section also creates a view that represents the section.

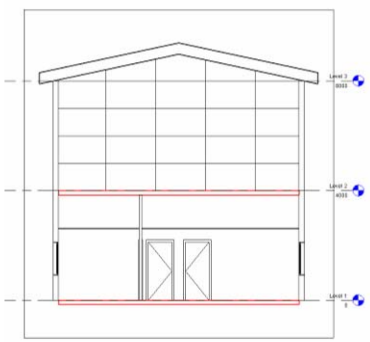
Reverse section views by clicking the arrow symbols that appear next to the section head.

Note: Place the section mark to the left of where you placed the curtain wall.

Section heads and tails can be turned on or off and toggled among the available loaded ones by clicking the circular arrow symbols next to the section head and tail.

32. Open the **section** by double-clicking the Building Section view that was automatically created in the Project Browser.

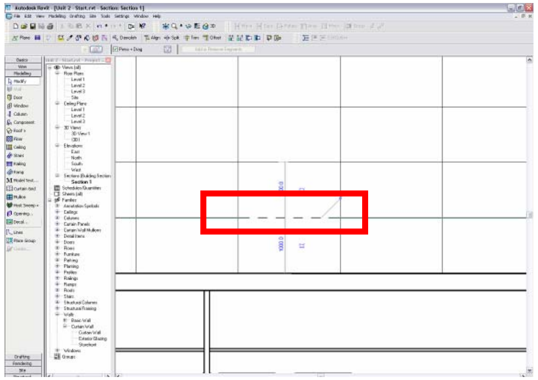
33. Select the floor slabs on Level 1 and Level 2 (use the **Ctrl** key) and on the Options Bar change the type to **Generic 300mm**.



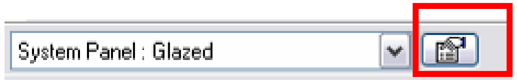
Another way to switch to the section view is by double-clicking the section marker in plan view. This method works only if the section mark is deselected, showing a blue section bubble.

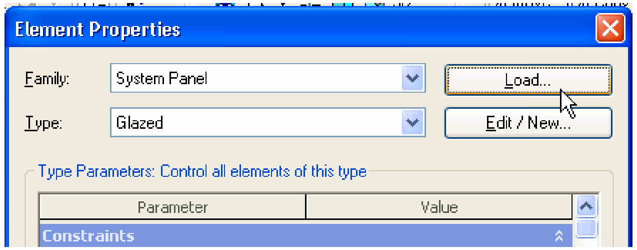
Modify the Curtain Wall Division, and Change a Curtain Panel into a Door Panel

34. Select the first gridline from the bottom of the curtain wall, and on the Options Bar click **Add or Remove Segments**. Click the middle segment to remove it.



35. Using the **Tab** key, select the new curtain panel that is twice as big as the other ones (position the cursor next to the side of the panel and press Tab until it is highlighted). Open the **Properties** dialog box by clicking the icon on the Options Bar.

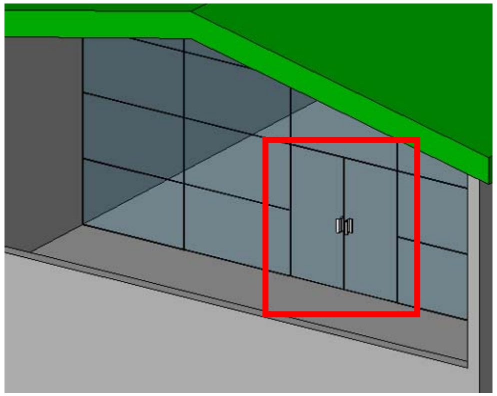




Load family components as needed during the design process.

36. Click **Load** and navigate to **Metric Library>Doors>M_Curtain Wall Dbl Glass.rfa**.

37. Click **OK** to accept and close the Properties dialog box. Open the **3D view** to see the change.



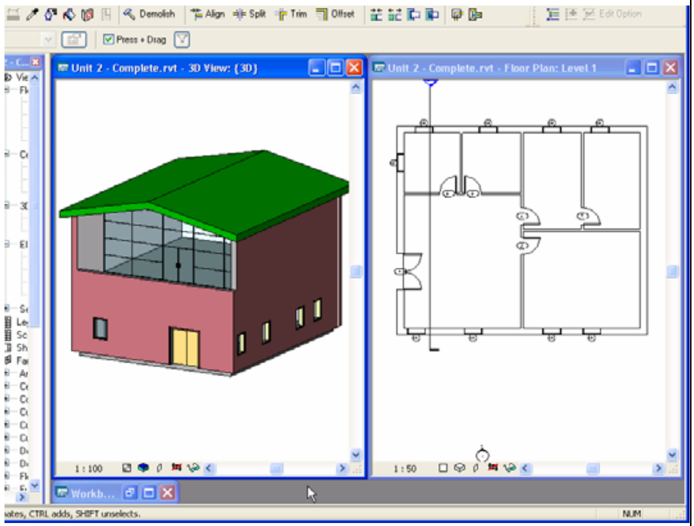
As you work with the different views, they remain open until you close them. Close Hidden Windows enables you to free computer memory by closing those windows that you are not using.

38. From the **Window** menu, choose **Close Hidden Windows**.

Copy Components from One Level to the Other

39. Open **Floor Plan Level 1**.

40. From the **Window** menu, choose **Tile**.

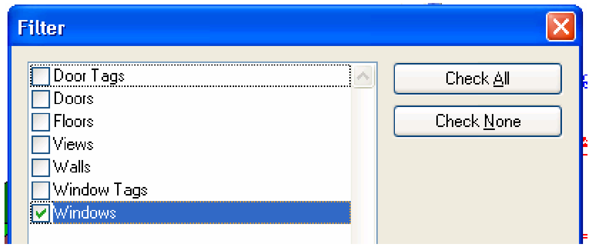


Tiling windows allows you to work in more than one view at a time.

This tool is particularly useful for selecting objects that may not be available to select from any one view.

Any windows that you have minimized at the time do not tile.

41. In plan view, draw a selection window around the building. Use the **Filter Selection** button to filter only the windows in the selection set.



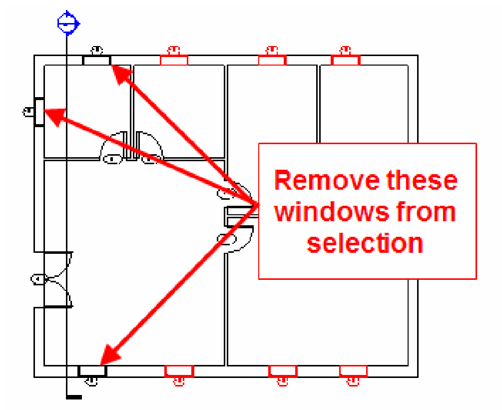
The default selection with the cursor movement is as follows:

- Left to right: Include only those objects entirely within selection box.
- Right to left: Include any element that lies within or is crossed by the bounds of the selection box.

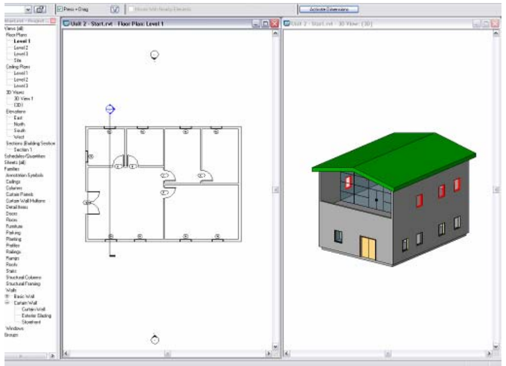
When selecting individual components:

- Ctrl+click adds to the selection set.
- Shift+click removes from selection set.

42. Press the **Shift** key and remove the windows on the left side (on the vertical wall and the first ones from the left on the horizontal walls) from the selection set.



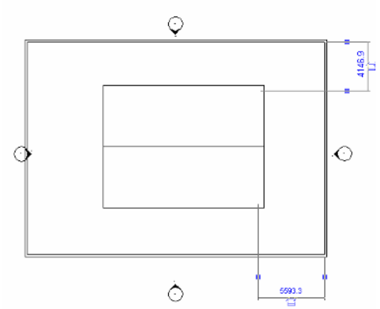
43. From the **Edit** menu, choose **Copy to Clipboard**. Then from the **Edit** menu, choose **Paste Aligned>Select Levels by Name>Level 2**.



Paste Aligned can be used on multiple levels at the same time by pressing Ctrl and clicking the level names in the dialog box.

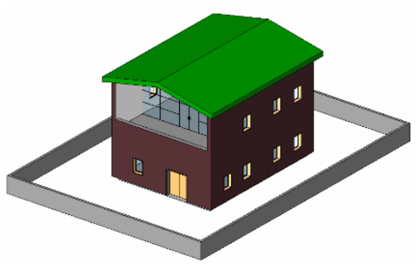
Modify a Wall Profile

44. Open **Floor Plan: Site**.
45. On the Basics Design Bar, click Wall and, from the Options Bar, select wall type:
    Generic200mm
    Height: Unconnected – 1500.
46. Draw four walls using the rectangle template from the Options Bar to create the wall around the building, as shown in image.

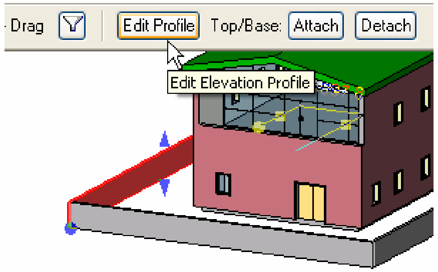


Change wall height as well as any other wall property after it has been positioned by opening the Wall Properties dialog box.

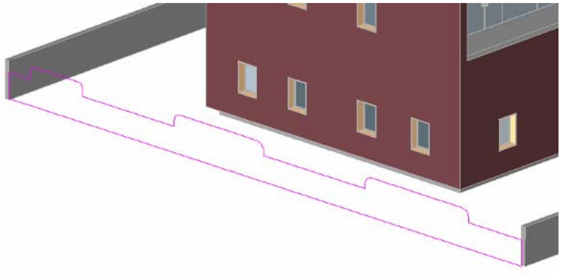
47. Open the **3D** view.



48. Select the north wall, and click **Edit Profile** on the Options Bar. You are in sketch mode.



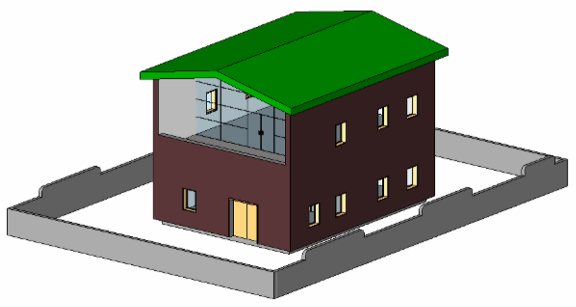
49. Select the top line of the wall and erase it. Create a new top profile for the wall using lines. Rotate the model for better visibility; use image as a guideline.
Click Finish Sketch when done.



When editing the wall profile, you are in sketch mode, and some specific rules are applied:

- All wall constraints are removed while sketching.
- The line that is constrained (usually the bottom and top lines) displays a lock if you select it.

50. Repeat the process with the south wall.



You can create rectangular openings in curved walls but not edit the profile. To achieve a different profile you must cut the wall with an in-place family.

Unit 3

Theory: Families and Nested Families

Autodesk Revit Building: Editing Types

In this lesson you work with families and types. You create a new wall type and window type from existing types in the project.

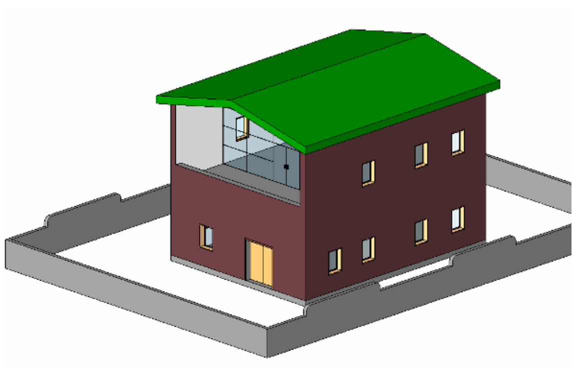
For the wall, you create a type with a sweep for a base and a reveal (cut-out) at the top. You also split the brick, adding a new component to the wall base. Wall types are system families. They do not exist outside the project environment.

Window families can be defined outside the project as RFA files or family files. For the window, you duplicate an existing window type to create a new size window.

Nested families and the Family Editor are explained in Units 10 and 11. This unit explains how to duplicate, edit, and manage a *system family* such as a wall.

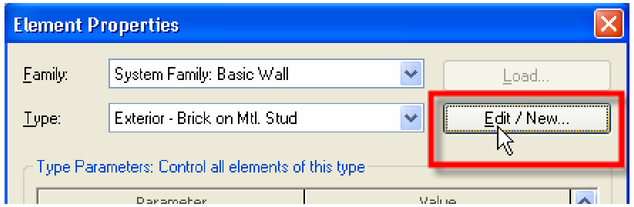
Duplicate a Wall Type

1. Open file **Unit 3 – Complete**. Open to the **3D view** and orient the view as shown.

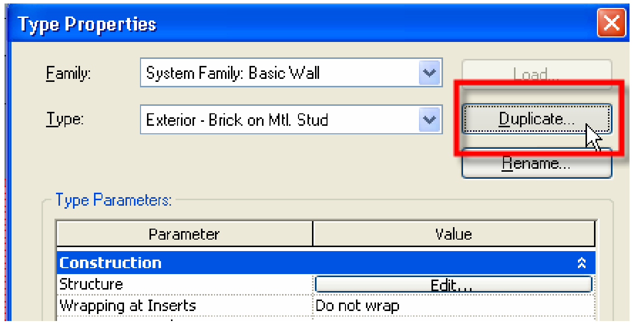


2. Right-click one of the exterior walls, and choose **Properties**.

3. Click the **Edit/New** button.



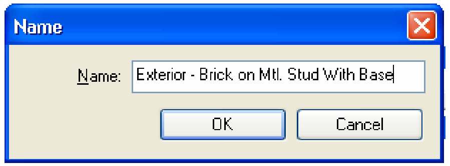
4. Click **Duplicate** and enter Exterior-Brick on Mtl. Stud with Base as the new name for the wall type.



To access a component Properties dialog box, select the component and do one of the following:

- Right-click the component, and choose Properties
- Select the component, and click the Properties icon on the Options Bar

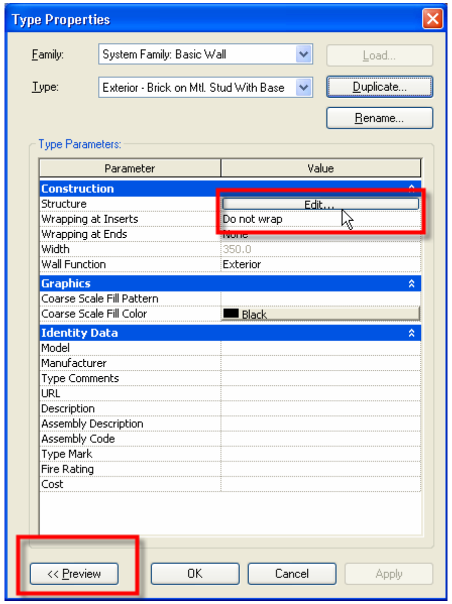
Sketch-based families have a Properties button on the Design Bar while in sketch mode.



It is a good idea to always duplicate an existing type instead of editing it directly, which would change the standard Autodesk Revit Building library. You can easily purge excess types later.

5. Click the **Structure Edit** button.

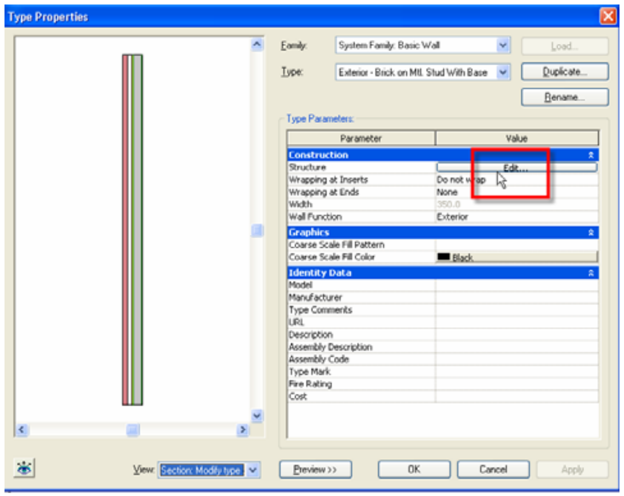
6. Click the **Preview** button in the bottom left of the dialog box.



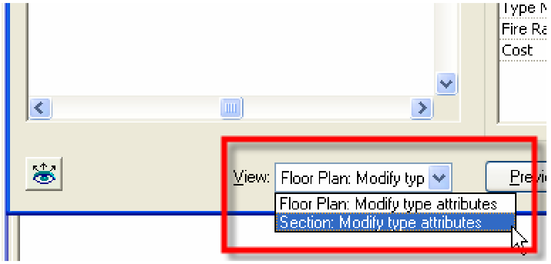
The Preview pane displays the components in the views selectable from the drop-down menu below the preview.

Load and Add a Wall Sweep

7. Click the **Edit** button under the **Structure** field.



8. Default view is plan structure. In the drop-down menu located on the left pane, select **Section**.



Every wall component has the following properties: layer, function, material, and thickness. Wall components can "wrap" around the wall end or at inserts.

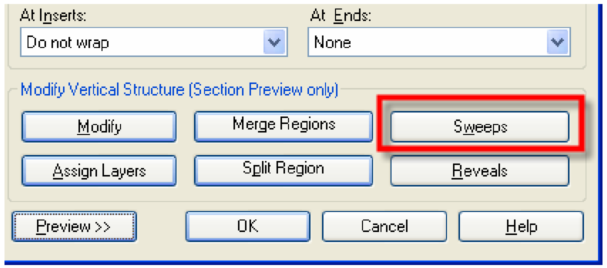
The layer determines how wall components clean up with each other.

The material determines what hatch is shown when the wall is cut in section or plan or viewed in elevation along with the shading and rendering textures. Materials also affect how walls clean up.

Note that the lower part of the structure window becomes active only if you switch the preview to Section.

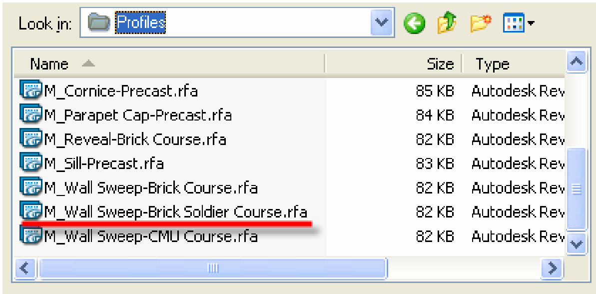
Note that the lower part of the structure window becomes active only if you switch the preview to Section.

9. Click the **Sweeps** button in the right pane. The Wall Sweeps dialog box opens.

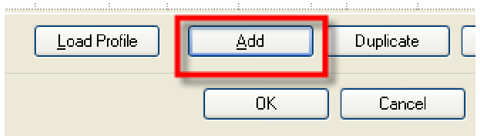


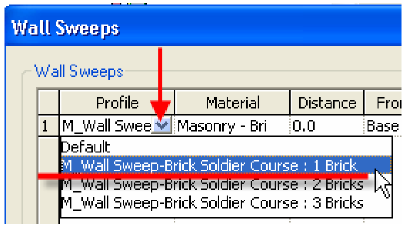
Sweeps and reveals are profile-based. The sweep and reveal dialog boxes allow for direct profile loading.

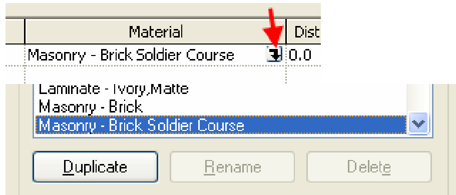
10. In the Wall Sweeps dialog box, click the **Load Profile** button.
11. Browse to the Metric Library>Profiles.
12. Click M_Wall Sweep Brick Soldier Course.rfa.
13. Click Open.



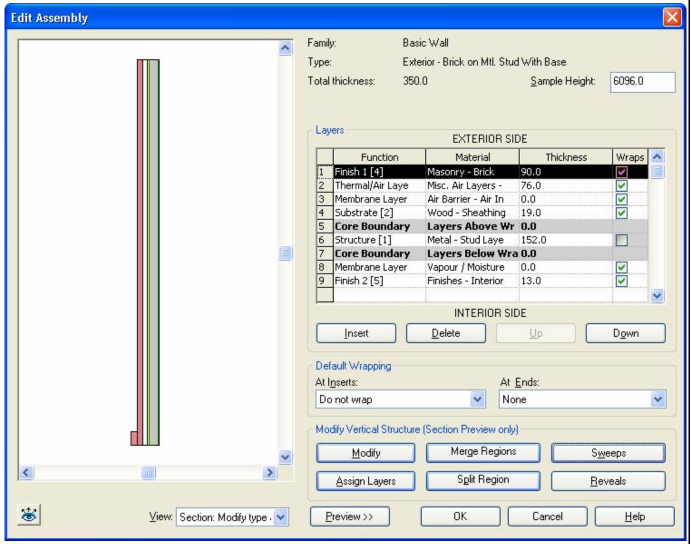
14. In the Wall Sweeps dialog box click the Add button.
15. Add one sweep:
- Wall Sweep - Brick Soldier Course 1 Brick
- Material = Brick Soldier Course
16. The other values should default to the values shown.
17. Use the drop-down dialog box to set the profile to the Soldier Course : 1 Brick.
18. Click the Material line.
19. Click Browse icon.
20. In the material selection page, double-click Masonry Brick Soldier Course.







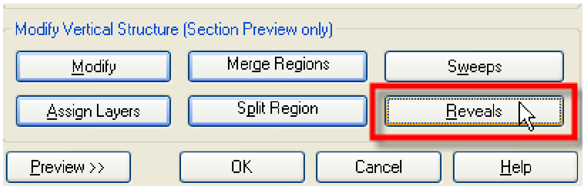
21. Click OK to return to the Edit Assembly dialog box.



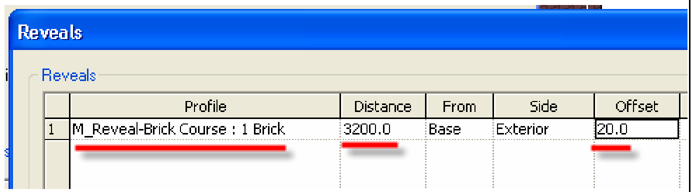
Add a Reveal

A reveal is like a sweep, but instead of adding to the wall form, it subtracts from it. The process and dialog boxes are the same.

22. Click the Reveals button.



23. Click the Add button.
24. Set the reveal profile to M_Reveal-Brick Course : 1 Brick.
25. Set distance to 3200.
26. Set offset to 20.

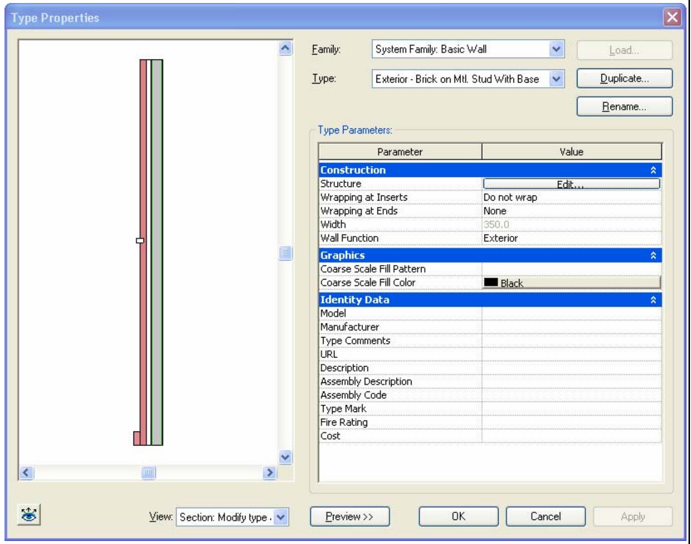


The profile determines the shape.

The distance determines how high to place the reveal on the wall.

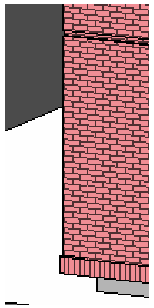
The offset moves the reveal into or out of the wall.

27. Click OK to return to the Edit Assembly dialog box.



The reveal has been applied to the wall. The reveal displays as the profile shape until you return to the drawing window.

28. Click OK two times to return to the drawing window.



The sweep and reveal are applied to the wall. The sweep adds a soldier course base. The reveal removes a strip from the brick at 3200mm.

More on sweeps

Walls cannot have vertical sweeps set in the type, but they can be added manually from Modeling Design Bar>Host Sweep>Wall Reveal/Wall Sweep. You can also use this tool to create a horizontal instance of sweeps or reveals.

Sweeps and reveals clean up correctly at angles and at inserts unless the inserted family contains specific solid elements in the family itself (that is, an exterior or interior door frame) that may interfere with the sweep/reveal.

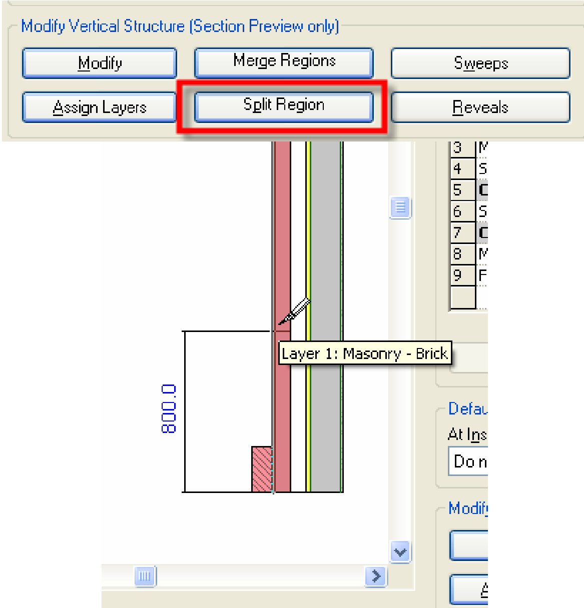
It is possible to grip-edit sweep at inserts and corners to redefine them. It is also possible to modify the sweep return around the corner. Select any sweep and check the available options on the Options Bar.

Split the Brick Layer

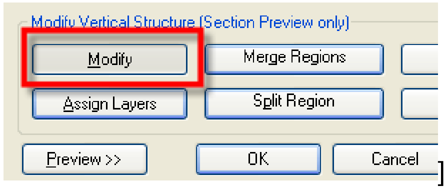
You can split the vertical components of a wall, adding different materials.

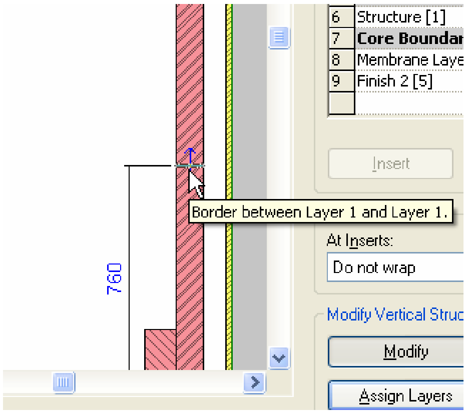
29. Return to the Edit Assembly dialog box for the wall you have been working with.
30. Click the wall with the reveal and sweep. Right-click and choose Properties. Click Edit>New. Click the Structure Edit button.

31. Click the **Split Regions** button. Hold your cursor over the masonry brick exterior layer on the preview, and click near the bottom of the wall to divide the brick structure into two parts.



32. Click the **Modify** button, and click the line dividing the two brick regions.

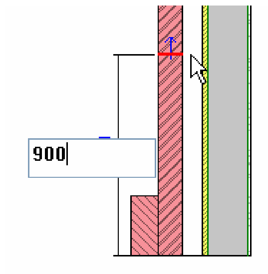




Once the regions are divided, it is not possible to edit the width of the component, as the system sets the default value to “variable thickness” according to how it is used within the wall type. That is, you could assign the same layer material to two different regions, laying on two different components, each with a different width.

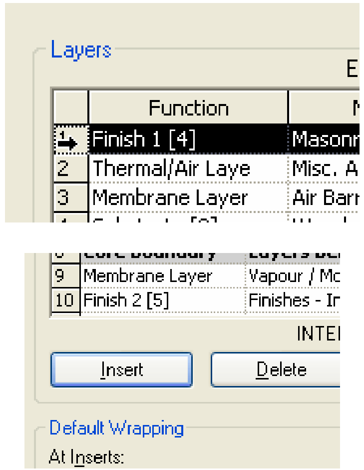
You can split wall components into as many regions as you want, but creating complex walls should be done only when the design idea and the construction method are clear. Otherwise, editing the regions can become difficult when there are many of them.

33. With the edge selected, use the temporary dimension that appears to move the line to **900 mm** above the bottom of the wall. Click the text of the temporary dimension, and type 900.

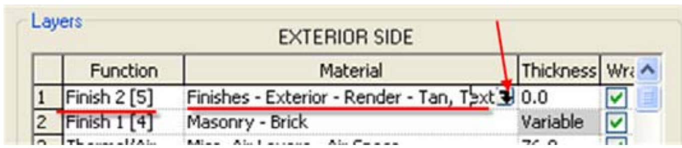


Add a New Wall Component

34. Click Layer 1. Click the **Insert** button to create a new layer.

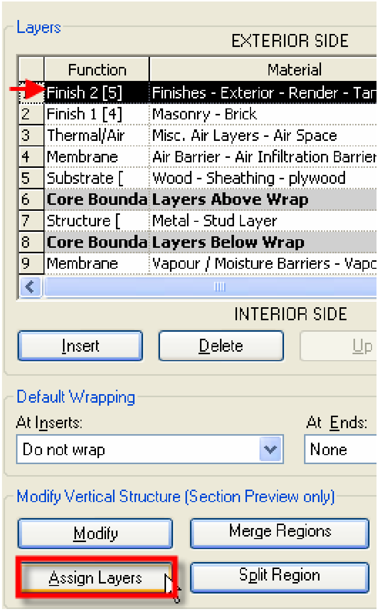


35. Change component settings:

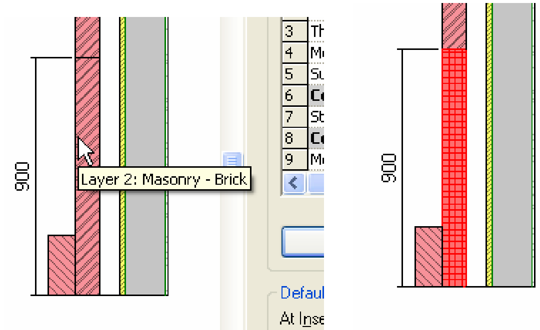


a. Function: Finish 2 [5]
b. Material: Finishes - Exterior - Render - Tan, Textured
c. Thickness: Do *not* change

36. Make sure the layer row with the new component is selected. Click the **Assign Layer** button.



37. Click the lower part of the exterior brick component in the Preview pane to assign the new wall component to it.



38. Click **OK** twice to close the dialog boxes.

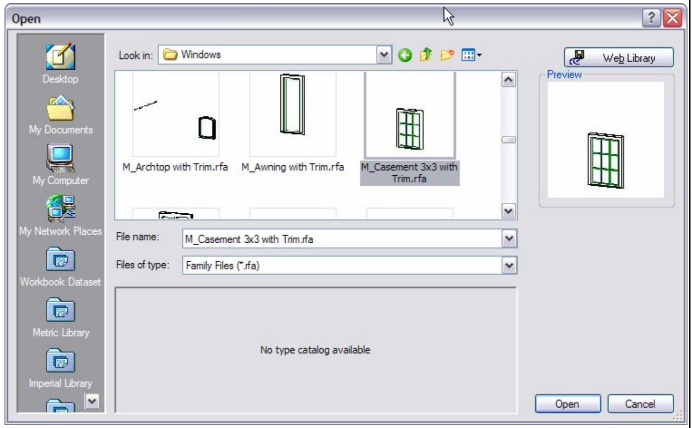
39. Select the remaining three exterior walls, and change their type from the Options Bar to the newly created type.

Load a Window Family

40. From the **File** menu, choose **Load from Library>Load Family** and navigate to the default **Metric Library>Windows** folder.

41. Activate the preview in the browsing window to see previews of the window types.

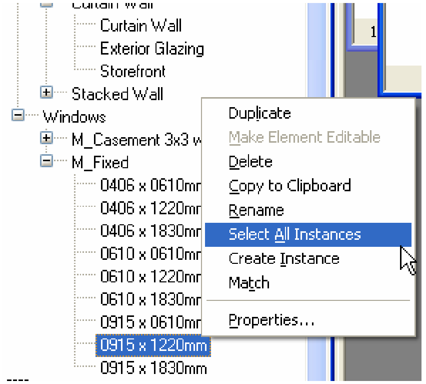
42. Select the window family called **M_Casement 3x3 with Trim.rfa.**



This is one of many ways to load families. In Unit 2 you loaded a family directly from the component's Properties dialog box. You will see more ways to load families later.

Duplicate a Window Family

43. From the **Project Browser**, select **Families>Windows>M_Fixed,** right-click 0915 x 1220mm**,** and choose **Select All Instances.**

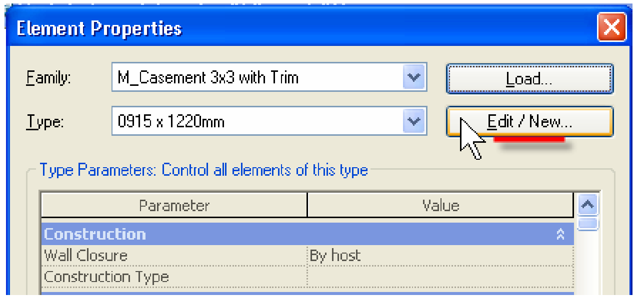


Selecting families from the Project Browser is a convenient way to create a selection set for a specific family type. Because it is not view specific, it selects all types contained in the model.

You can also select all instances by right-clicking one of the windows in any view and choosing Select All Instances from the context-sensitive menu.

44. On the Options Bar, change the window type to **M_Casement 3x3 with Trim 0915 x 1220mm.**
45. Without deselecting the windows, right-click and choose **Properties.**

46. Click the **Edit/New** button.

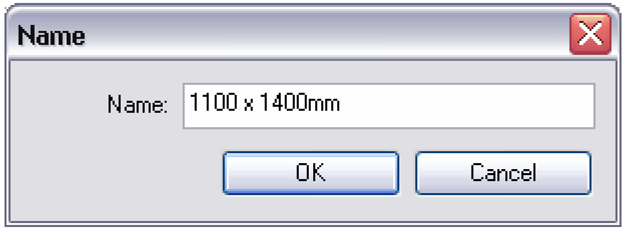


The Edit/New button opens the Type's element Properties dialog box. You can define Type parameters and Instance parameters during family creation.

47. Click the **Duplicate** button.

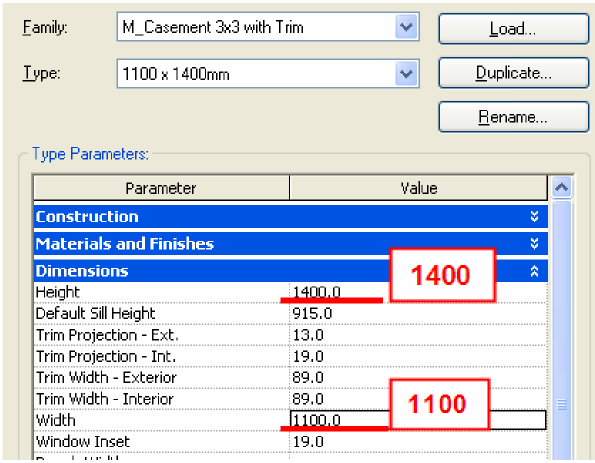
Duplicating the window type and modifying the window family does not automatically update the family file (RFA) stored outside the project file. You export the family to your library at the end of this exercise.

48. Create a new type named **1100 x 1400mm.**



It's a convention to name types using their size so that other people using families can easily trace and understand them. In a team, conventions are a fundamental part of the design process optimization in order to share the data consistently.

49. Change **Height** value to **1400** and **Width** value to **1100**.

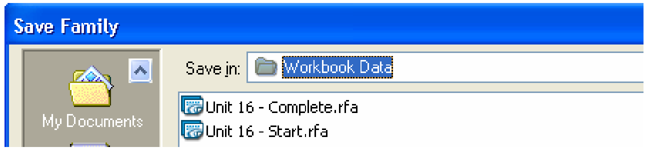


There are many parameters in this dialog box that vary in type: length, material, text, and other component-specific properties. Try changing the materials to see what happens.

50. Click **OK** twice to close all dialog boxes.

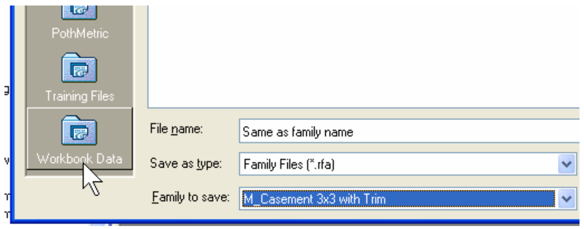
Export the Window Family

51. From the File menu, choose **Save to Library**



Remember to save in a location that makes sense. In this example it is the *Workbook Data* folder. Always keep your personal libraries separate from the default installed library.

52. From the Family to Save drop-down menu, select the family **M_Casement 3x3 with Trim**.



If you save your libraries in the same folder as the Revit Building libraries, you might lose all of them if you forget to pull them out before upgrading to the next release of the software. So, make it a habit to create your own library folder.

Unit 4

Theory: Parameters

Autodesk Revit Building: Dimensions, Doors, and Windows

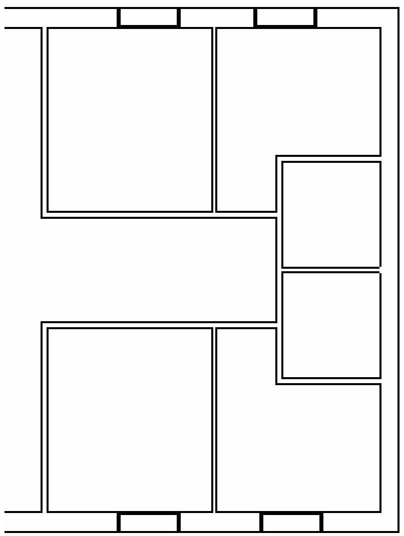
In this unit you explore dimensioning of doors and windows.

Dimensions for Locating Objects
When you work with doors, you work with both the temporary and permanent dimensions. Temporary dimensions appear any time a model object is selected in a view. When the object is deselected, the dimension disappears. Permanent dimensions are an annotation placed in the current view. Permanent dimensions are specific to the view and do not show up in other views. Dimensions are much more than instructions to the contractor to build these elements at this location. Dimensions in Revit Building are one of the mechanisms for locating objects accurately in the building model.

Dimensions for Modifying Subcomponent Locations Within a Family
In the second section of this exercise you work with dimensions within the window family. Many families have parameters allowing control of the relationships and locations of the subcomponent parts. This relationship is often established by family type. Modifying these parameters affects all instances of that type. Also defined by the family are instance parameters. A general rule is that the instance parameters control the location of an object within its host. Each of these parameters is determined by the author of the family. They can differ from family to family, and you will become familiar with accessing both the instance parameters and type parameters when working in the Revit Building environment.

Add Doors and Locate with Temporary Dimensions

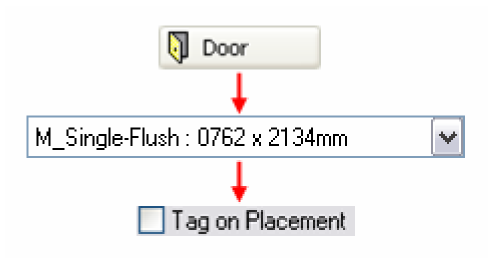
1. Open file **Unit 4 – Start**. Open **Floor Plan Level 2**. Zoom into the east area of the building.



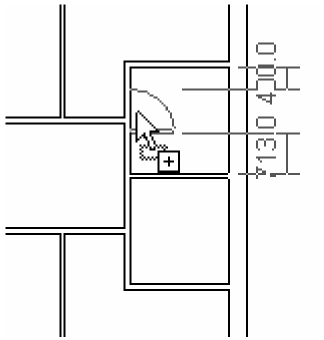
These walls have been added for you.

2. From the **Basic** Design Bar select **Door** and from the Options Bar, select door type: **M_Single-Flush: 0762 x 2134mm.**

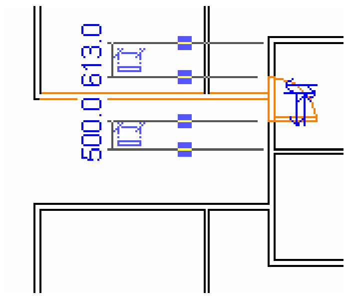
3. On the Options Bar, clear **Tag on Placement.**



4. Position the cursor over the vertical wall, as shown in the image.



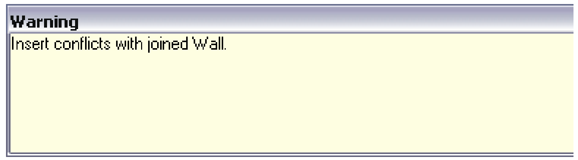
5. Click to place the door. Try to place it so that the opening is in front of the perpendicular wall.



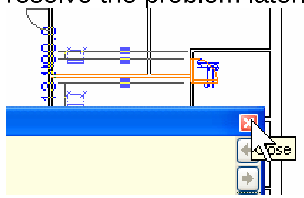
The door opening side is defined while positioning the door by moving the cursor from one side of the wall to the other.

Pressing the spacebar while positioning allows changing of the swing direction.

A Warning dialog box displays if there is a conflict between the door and the wall.

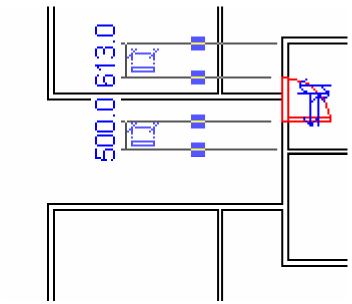


If you want, you can ignore this warning and resolve the problem later.



Click the Close X to dismiss the warning or just proceed to the next door.

6. On the **Basic** Design Bar, click **Modify**, and select the door.

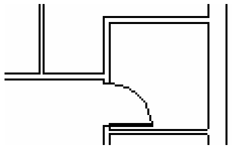


When you select a door, two symbols appear. Use them to invert opening side and/or swing direction.

 Invert swing.

 Invert side.

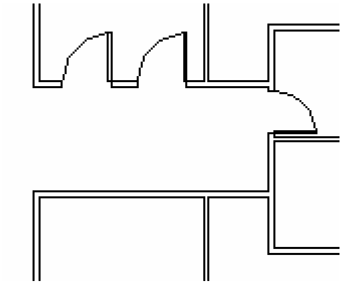
7. Click the text of the dimension that is attached to the horizontal wall in the middle. The value becomes editable. Type **5cm** and press Enter.



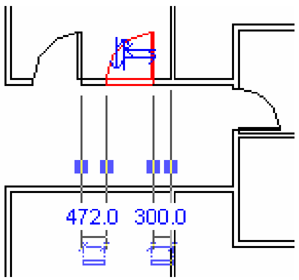
8. On the **Basic** Design Bar, click **Door** and from the Options Bar, select door type: **M_Single-Flush: 0864 x 2134mm.**

9. On the Options Bar, clear **Tag on Placement**.

10. Place doors, as shown in the image. Use temporary dimension to get an idea of location relative to walls.



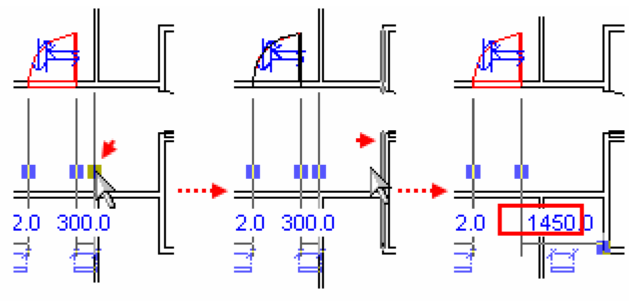
11. Select door on the right side. Temporary dimensions appear, but they won't help you to adjust the position for this door, which must be placed in the adjacent room.



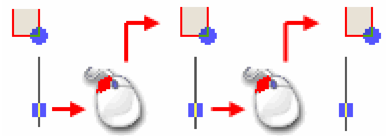
You can edit temporary dimensions with the control boxes (blue squares) on each witness line. Just click a control box and drag it to a new position or right-click it and choose Move Witness Line from the context-sensitive menu.

12. Drag the blue square to a new position (face of the vertical wall) and then release to validate the position, as shown in image.

13. Click the text of this dimension, and the value becomes editable. Type **10cm** and press Enter.



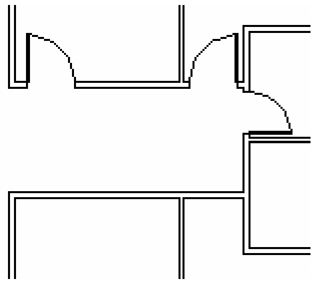
Note: You can click these control boxes (blue squares) to move the witness line to another reference point. Following is an example for a wall, but it works for doors, windows, and so on.



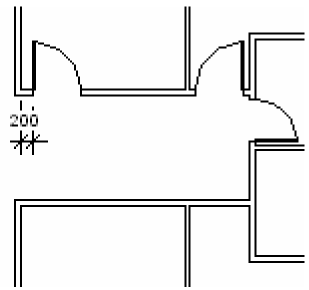
Click these control boxes to move the witness line to another reference point. There is a limited set of points the witness lines will find with this method.

By dragging this control box, you can move to entirely different objects.

14. Select the door on the left side. With temporary dimensions, adjust the position so that the door is placed **20cm** from the vertical wall on the left.
15. Click horizontal control arrows to flip the door.

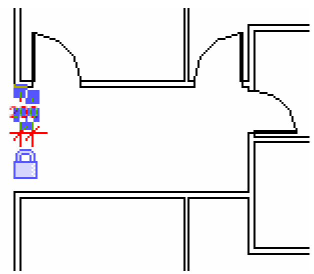


16. With the door still selected, click the symbol ( ). The temporary dimension becomes a permanent dimension.



You can use permanent dimensions to annotate your design, and they can be useful to place a relationship between components.

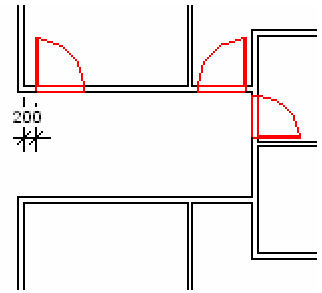
17. Press **Esc** twice and select the permanent dimension that you just placed. Click the blue lock near the dimension line.



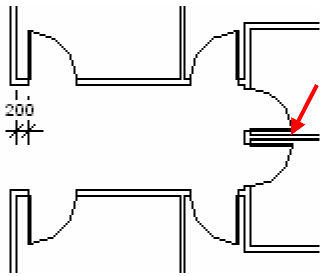
When you click to lock the dimension, you are creating an explicit relationship. If you move the wall, the door retains its position relative to the wall.

If you delete a dimension that establishes a relationship, Autodesk Revit Building displays a warning asking what you want to do. You can delete the dimension and keep the relationship or simply delete the dimension and the relationship.

18. On the **Basic** Design Bar, click **Modify**. Select the three doors (use **Ctrl** to multiselect), and on the **Edit** toolbar, click **Mirror**.



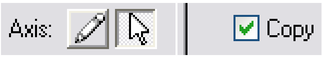
19. On the Options Bar check that **Pick** and **Copy** are selected. Click the horizontal wall on the right side.



Use the Options Bar to

- Draw or select an axis for the mirror.

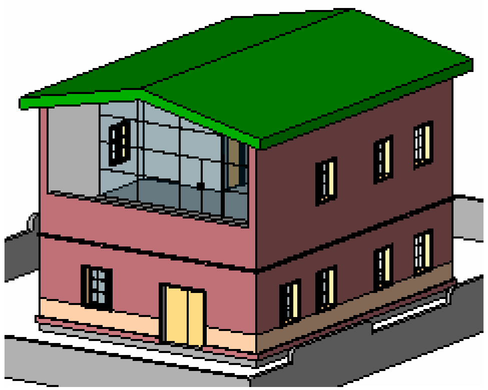
- Choose if you want to copy the mirrored objects.



Load a Door Family and Change a Type

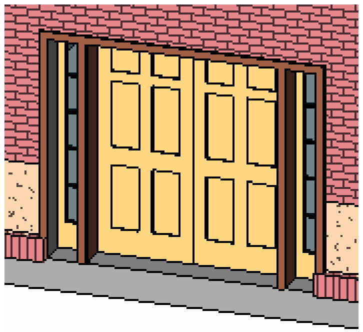
20. From the **File** menu, choose **Load from Library**>**Load Family**. Navigate to the *Doors* folder where you have saved the data set. Select **Double-Raised Panel with Sidelights.rfa** and click **Open**.

21. Open the 3D view and rotate the model so that you can see the double door.



The easiest way to rotate the model is by pressing the Shift key and the middle button of the mouse at the same time.

22. Select the door, and from the Options Bar, select **Double-Raised Panel with Sidelights: 1830 x 2134 mm** in the type selector.



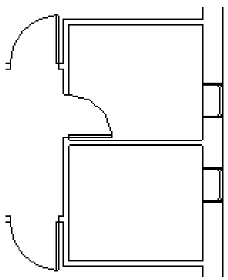
Change Type and Instance Parameters

23. Open Floor Plan **Level 2**.

24. On the **Basic** Design Bar, click **Window** and on the Options Bar, click **Load**.

25. Navigate to the Metric library*Windows* folder, select **M_Casement with Trim.rfa**, and click **Open**.

26. On the Options Bar, click **M_Casement with**



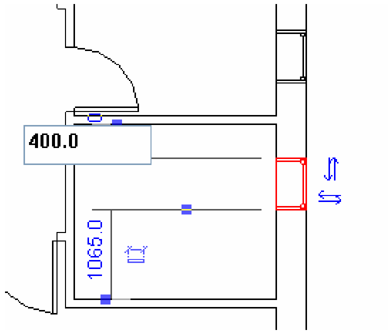
You can a load a family in a project in many different ways:

- Choose Load from Library>Load Family from the File menu
- Select the corresponding button on Design Bar and click Load on the Options Bar
- Drag a family from Microsoft® Windows® Explorer and drop it into

Trim: 0610 x 0610mm and clear **Tag on Placement**. Add two windows on the vertical wall (east side) using the image as a guide.

Revit Building

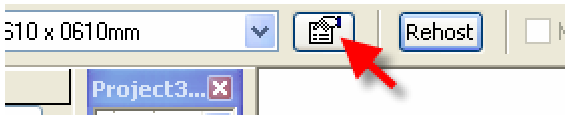
27. Using temporary dimensions, adjust the window's position at **400mm** from the horizontal wall.



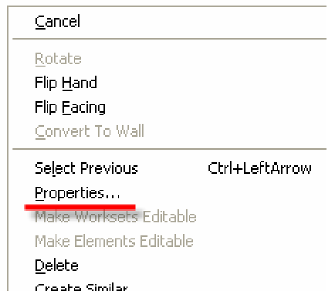
The casement window is like the casement 3x3 window, but without the muntins. Different geometry, different family.

28. Zoom around the windows.

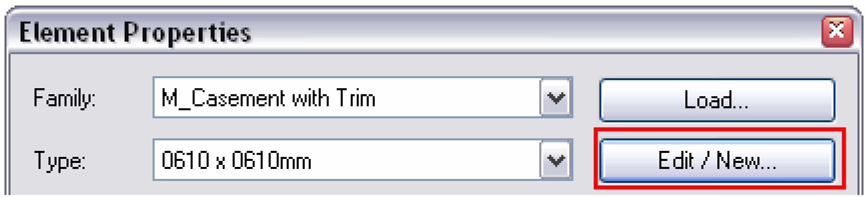
29. Select a window, and on the Options Bar click **Properties**.



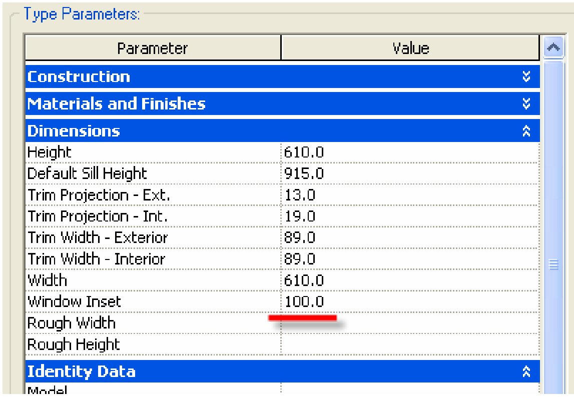
You can right-click to display the context-sensitive menu and then choose Properties.



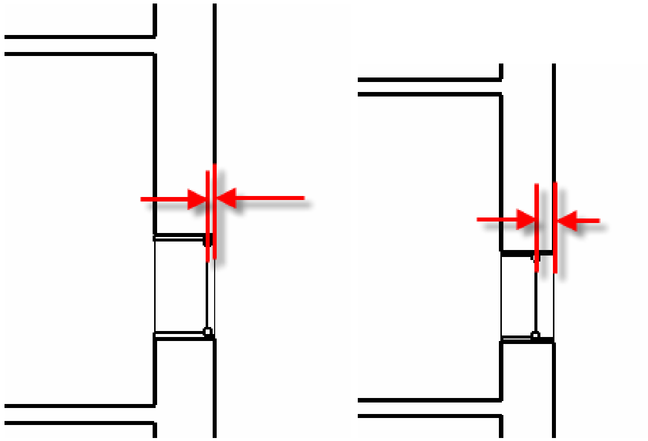
30. In the Element Properties dialog box, click **Edit/New.**



31. In the **Type Parameters** dialog box, change the **Window Inset** parameter to **100mm**.



32. Click **OK** in the **Type Parameters** dialog box and **OK** in the **Element Properties** dialog box to accept change and exit.

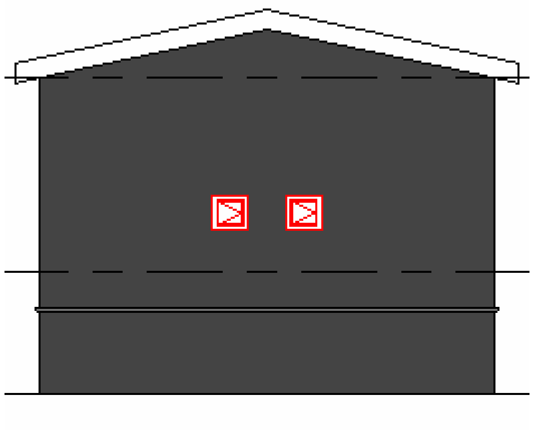


Before *After*

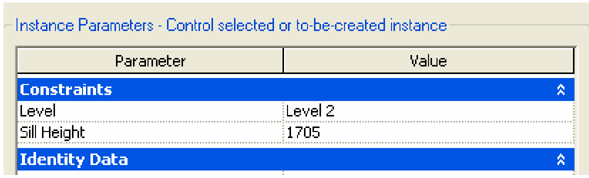
Window Inset is a type parameter. If you modify a type parameter, all the instances in the project that belong to the same type are modified accordingly.

33. Go to **Elevation East** and select the two windows.

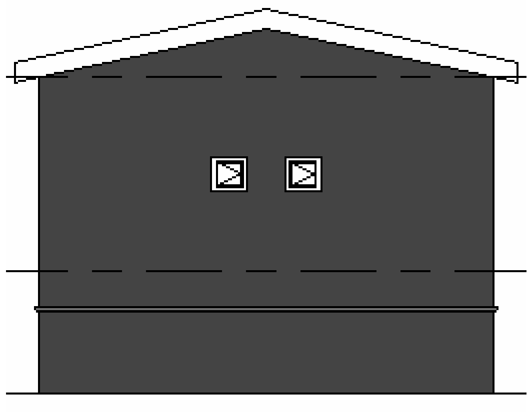
34. On the Options Bar, click **Properties**.



35. In the **Element Properties** dialog box, change the **Sill Height** parameter to **1705mm.**



36. Click **OK** in the **Element Properties** dialog box.



When you change an instance parameter, only the selected components are modified.

Unit 5

Theory: Representations

Autodesk Revit Building: Views, Visibility, and Sheets

This unit covers the display features and capabilities of Autodesk Revit Building, as well as covering some different presentation methods.
This unit includes four exercises:

- Exercise 5a leads you through adding a section and detail callout. This exercise also covers adding views to sheets.
- Exercise 5b adds some material to the roof of the building.
- Exercise 5c illustrates some fine-tuning control over the visibility and cleanup of wall in plan view.
- Exercise 5d demonstrates how to create a sun and shadow study for your model.
- Exercise 5e shows how to import a model created in Autodesk Revit Building to Autodesk® 3ds Max® software for visualization.
-

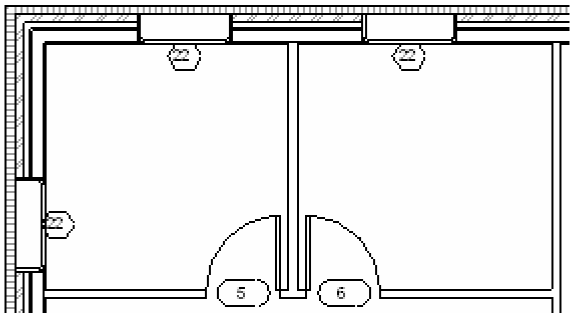
Unit 5, Exercise A: Sections, Views, and Sheets

In this exercise you add a section to the building. You then adjust the view properties for the section and add a detail callout to the section view. At the end of the exercise you create a new sheet and composite the views on the sheet.

This unit covers the display features and capabilities of Autodesk Revit Building.

1. Open file **Unit 5a – Start**. Open Floor Plan **Level 1**.

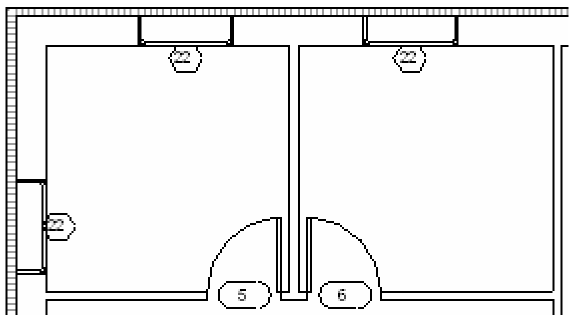
2. Zoom into the two first rooms on the left side of the building.



3. Right-click in the view, and choose **View Properties**.

You don’t have to open a view to edit the properties. You can simply right-click a view in the Project Browser and then choose Properties from the context-sensitive menu.

4. In the **Element (view)** Properties, change the **detail level** parameter to **Coarse** and click **OK**.

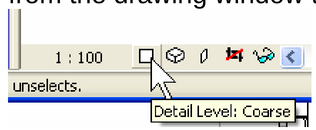


Note that in coarse mode the wall structure is no longer displayed.

When you set the detail level, the stucture is displayed. This setting is also accessible from the View toolbar.

Autodesk Revit Building allows three different levels of detail (Fine, Medium, and Coarse). Objects in the project display correctly for each detail level.

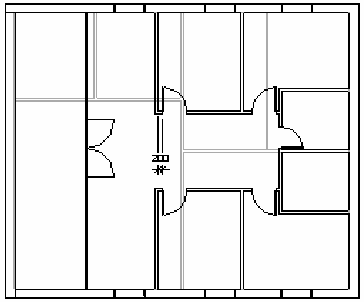
The Detail level of a view is also available from the drawing window toolbar.



5. Open Floor Plans - **Level 2.**

6. Right-click in the view, and choose **View Properties.**

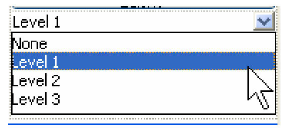
7. In the **Element Properties** dialog box, change the **Underlay** parameter to **Level 1**.



Autodesk Revit Building enables you to choose which view you want to use as an underlay. The view is displayed in gray, but you can use these elements for alignments or as a reference for new objects.

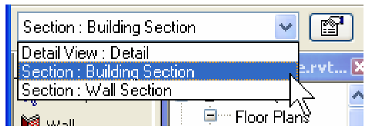
Any level in the building can be used as an underlay, or simply choose level below or level above.

You can choose to view the underlay in plan or reflected plan (ceiling) view.

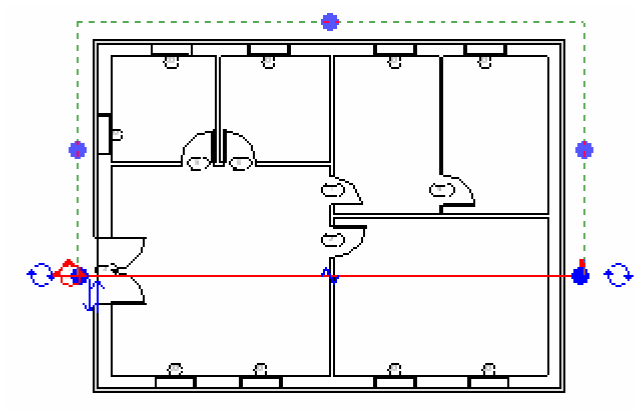


8. Open Floor Plans – **Level 1**.

9. On the **Basic** Design Bar, click **Section**. Set Type Section: Building Section.



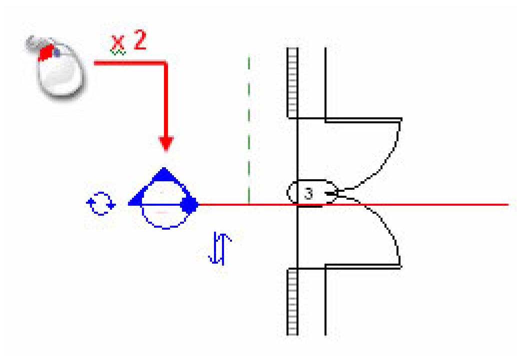
10. Draw a line from left to right. Use the image as a guide.



The direction used to draw the section line defines the direction of the section.

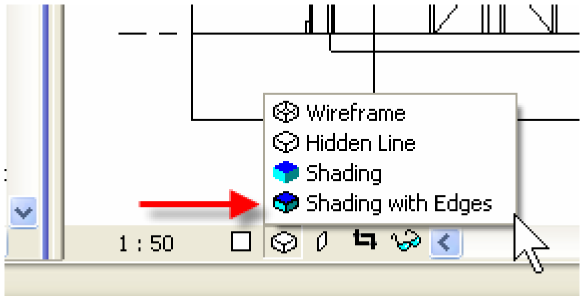
11. Click in a white area to end the command and return to the **Modify** tool. This should deselect the section at the same time.

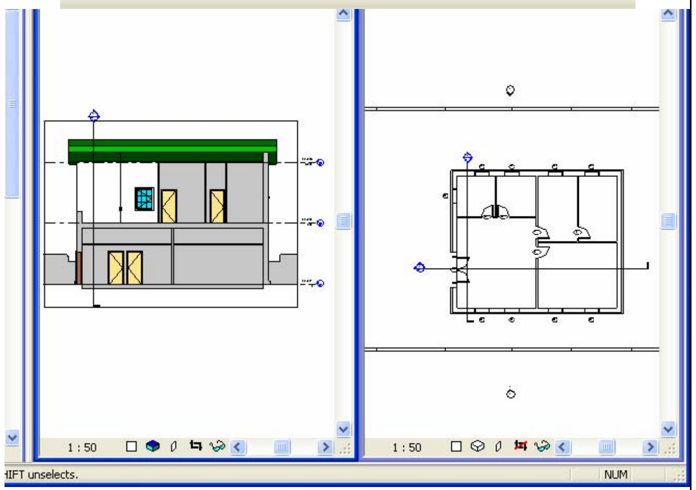
12. Double-click in the middle of the circle of the section bubble in the project. (The section bubble should be blue when you do this. In other words, it should *not* be selected.)



You can also right-click the section line and then choose Go to View.

13. Use the window view toolbar to select **Shaded with Edges**.
14. Type **WT** on the keyboard to tile the windows. Close any windows you do not want to see, and type WT to tile the windows again.

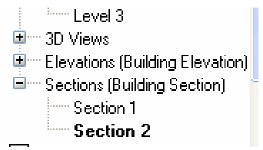




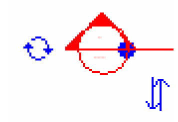
There are four model graphics style modes:

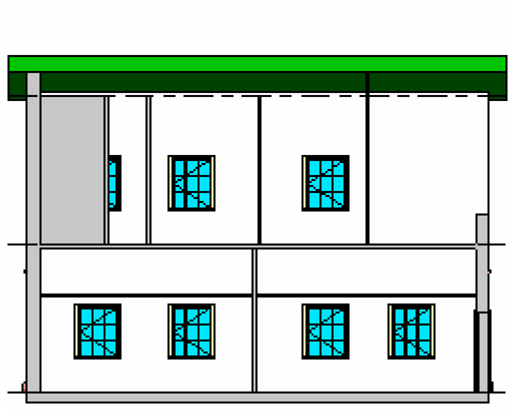
- Shading with edges
- Shading
- Hidden lines
- Wireframe

You have created a new view in the project. This view is automatically added to the Project Browser under Sections.



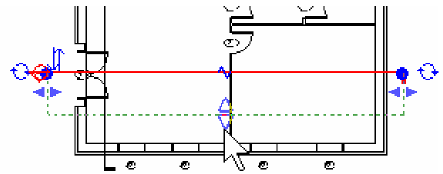
15. Go to Floor Plans – **Level 1.**
16. Select the section line. Some symbols are displayed next to the section line.
17. Click the arrow symbols to flip the section.
18. Open the section view.





 Flip the section.  Cycle through different symbols for the section line. Change the symbol at each end of the section line.

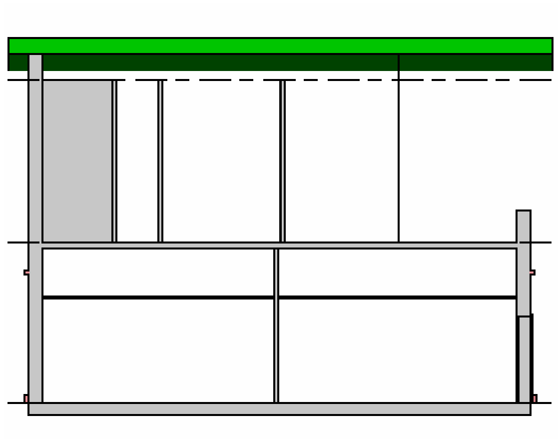
19. In **Floor Plans – Level 1,** select the horizontal section line.
20. Drag the blue double arrow (in the middle of the green dashed line) so that this point is above the exterior south wall.



When you move this point, you change a view parameter value: Far Clip Offset. You can change it in the view properties by assigning a value in the field.

Extents	
Crop Region	☑
Crop Region Visible	☑
Far Clip Active	☑
Far Clip Offset	1745.2
Scope Box	None

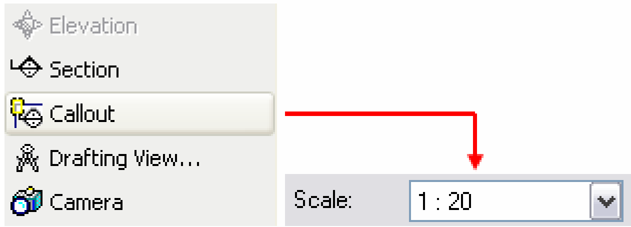
21. Make the section view active.



The section view is now cut by the far clipping plane.

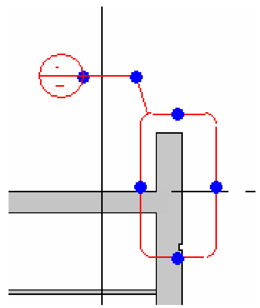
Add a Detail Callout

22. From the Design Bars **View** tools, click **Callout.**
23. On the Options Bar, change the Type to Detail Callout.
24. Check that Scale is set to **1 : 20**.



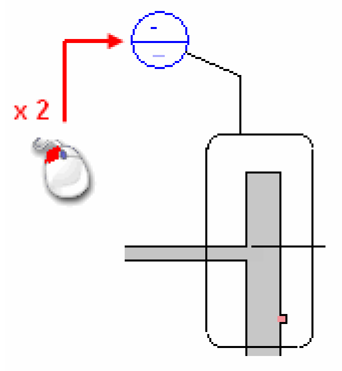
You can modify the scale later in the callout view properties.

25. Draw a detail frame (click and drag) around the intersection between the floor and the exterior wall on the right side of the building, as shown in the image.

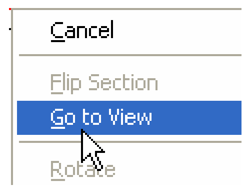


Adjust the size of the frame and replace the bubble by dragging the blue grips.

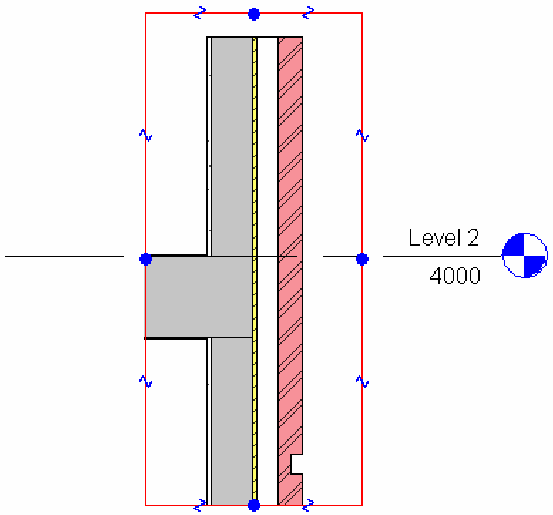
26. Double-click the bubble that is attached to the callout frame.



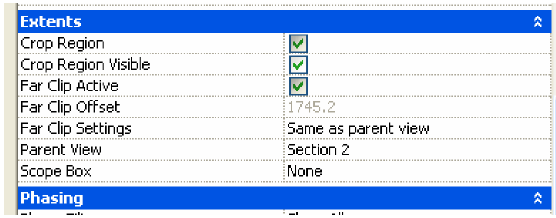
A callout view can be opened like the section view. Right-click the symbol, and then choose Go to View.



27. Select the frame around the view. Use the blue grips to resize the view so that you see only what you want to show in this callout.



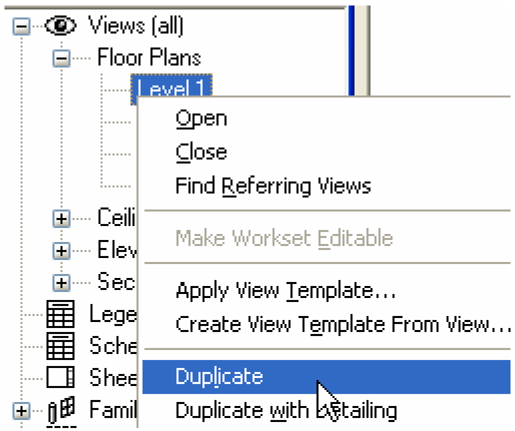
Display this frame in any graphical view. It's a view parameter named: Crop Region.



Extents	
Crop Region	☑
Crop Region Visible	☑
Far Clip Active	☑
Far Clip Offset	1745.2
Far Clip Settings	Same as parent view
Parent View	Section 2
Scope Box	None
Phasing	

In a callout view (as in any other view) you can use detail tools. See Unit 14 for a complete description of this process.

28. From the Project Browser, right-click **Floor Plans - Level 1,** and choose **Duplicate**.



Duplicate a view with detailing (Duplicate with Detailing) or without (Duplicate). If you choose Duplicate, then none of the detail components (those that are view specific, such as dimensions, tags, annotations) are duplicated.

29. From the Project Browser, right-click **Copy of Level 1,** and choose **Rename** from the context-sensitive menu.

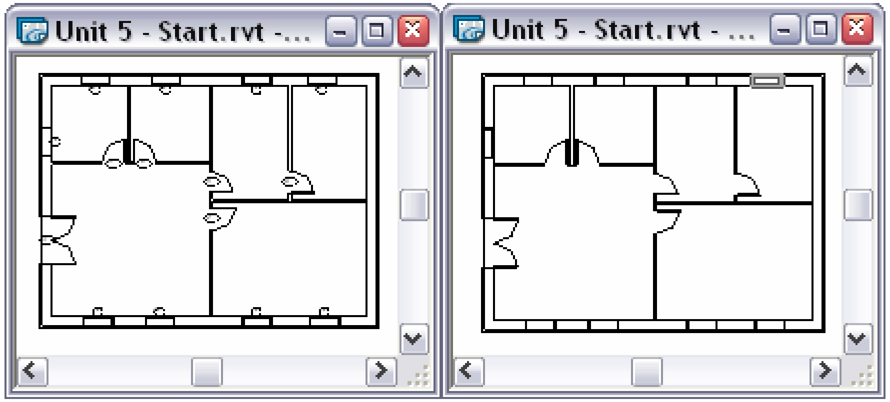
30. In the Rename dialog box enter a new name for the view: **Level 1 – Area,** and click **OK**.

31. From the Window menu, choose Close Hidden Windows.

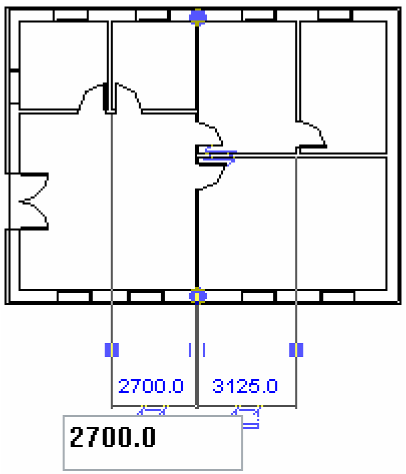
32. In the Project Browser open **Floor Plans – Level 1**.

33. From the **Window** menu, choose **Tile**.

34. You can now see the views side by side.



35. In any view, move a wall. Notice that in all other views, that wall moves accordingly.



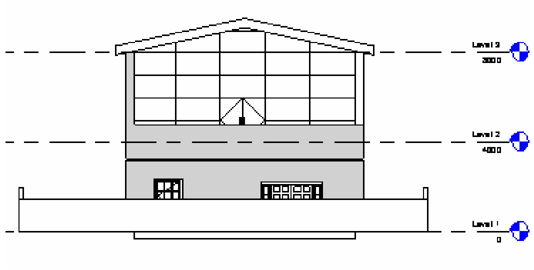
Keep in mind that it's the same wall in the same building. When you move that wall in any view, all other views where that wall is visible automatically update.

Even if you copy a view you can choose to display it with a different scale, different detail level, different shading mode, and so forth.

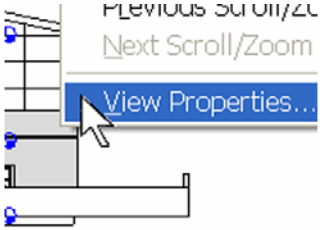
Working with Shade and Shadow

Autodesk Revit Building provides the ability to work with shade and shadow directly in any view. This is part of the view properties called advanced model graphics.

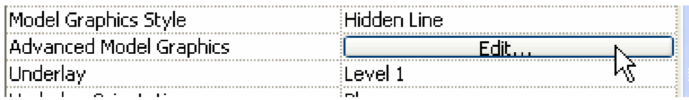
36. Set the West Elevation current.



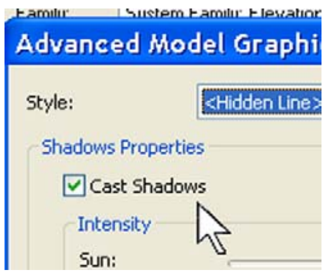
37. Right-click in the view, and choose View Properties.



38. Click the Advanced Model Graphics>Edit button.

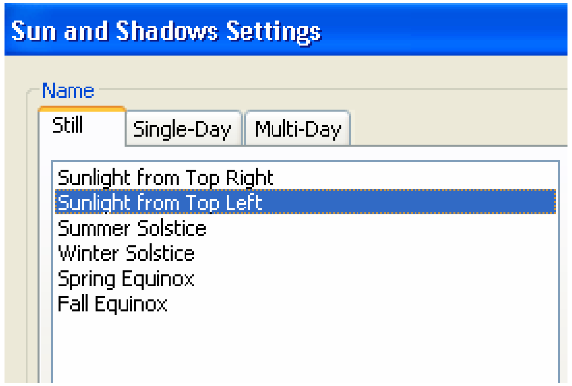


39. Select Cast Shadows.



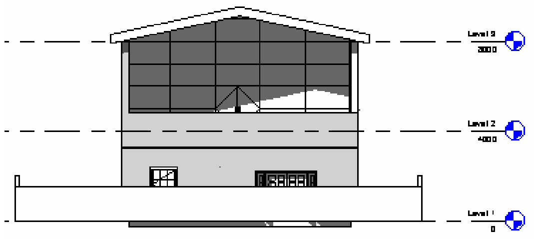
40. Click the browse arrow for Sun and Shadows Settings.

41. Change the preset to Sunlight from Top Left.



This is in relationship to the plan view of the building.

42. Click OK three times to return to the drawing window.



The shadow is now generated on the elevation.

If the shadows do not show up immediately, change to a different view and return to this or try the refresh key (F8) on your keyboard.

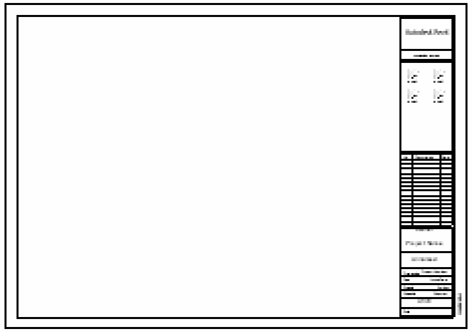
Creating Sheets

In Autodesk Revit Building, a sheet is another view of the building model. Sheets are listed in the Project Browser in their own category directly above the family list. The overall flow is as follows:

- Create a sheet.
- Place any view (plans, sections, elevations) on the sheet by dragging it onto the sheet view.
- Adjust the properties of the plan view to meet your presentation needs.

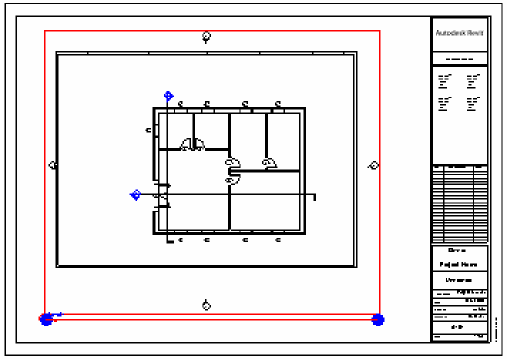
43. In the Project Browser, right-click **Sheet** and choose **New Sheet** from the context-sensitive menu.

44. In the **Select a Titleblock** dialog box, click **OK** (use the default **A1 metric**).



To choose another title block, you have to first load them in your project. To load a title block, click the Load button in the Select a Titleblock dialog box.

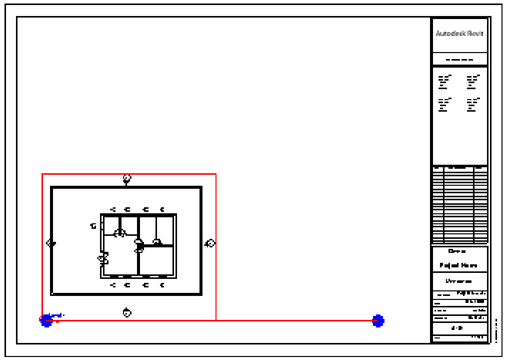
45. From the Project Browser, drag **Floor Plans – Level 1** onto the sheet.



Autodesk Revit Building won't let you place the same view twice on a sheet or the same view on two separate sheets. Instead, you duplicate the view you want place on two separate sheets.

The crop region determines the size of the view on the sheet. By default, the view is set to the extents of the objects in this view.

46. In the Project Browser, right-click Floor Plans – Level 1, choose Properties, and change View scale parameter to 1: 100. Click OK.

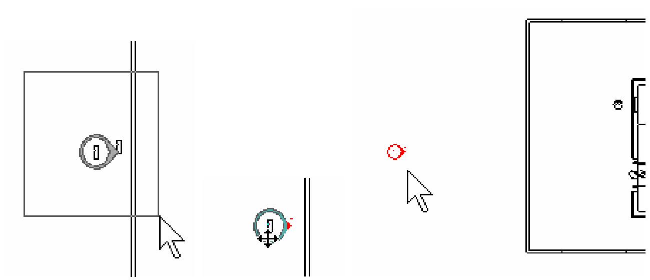


The view's scale determines how large an area it takes up on the sheet.

47. Open Floor Plans Level 1.

48. Select the elevation marker with a window selection with the cursor.

49. Drag the elevation marker away from the surrounding low wall.

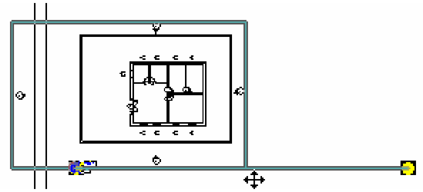


The elevation mark has two pieces: the square and the triangle. Select them both.

50. Open the sheet.

51. Notice that the size of the view now incorporates the new location of the elevation marker.

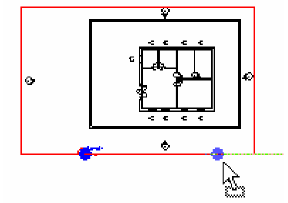
52. Move the view into the middle of the sheet.



The title of the view also moves with the plan view.

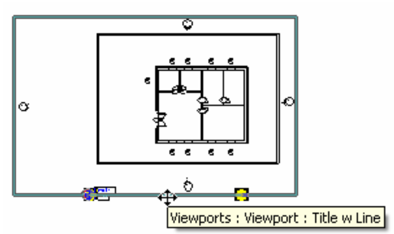
53. Click the view border to activate the blue grips.

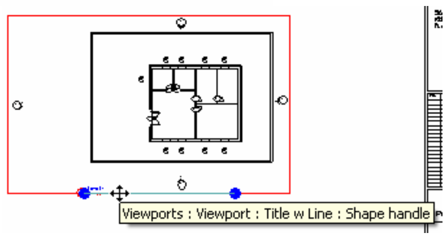
54. Grip stretch the right grip to make the title line shorter.



55. Drag the title line at the lower left underneath the plan view into place.

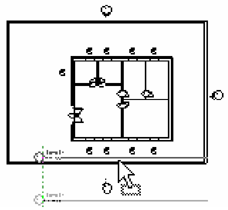
56. Hold your cursor over the title mark and press the Tab key until you cycle through to Viewports: Viewport: Viewport 1: Shape Handle.





If you cannot get the tooltip to appear with Viewports: Viewport: Viewport 1: Shape Handle, watch the status bar at the lower left for the same information.

57. Click the left mouse button, and drag the title mark into place.

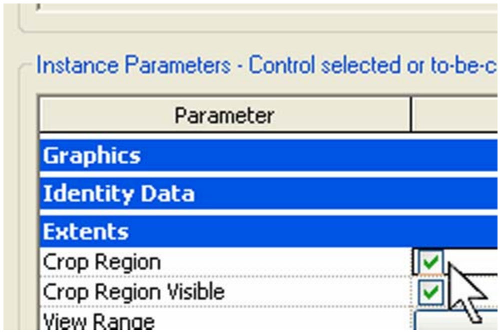


Adjust the Crop Region for the View

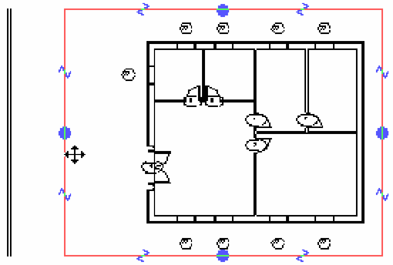
58. In the Project Browser right-click Floor Plans – Level 1 and choose Properties.

59. Turn on the crop region for the view.

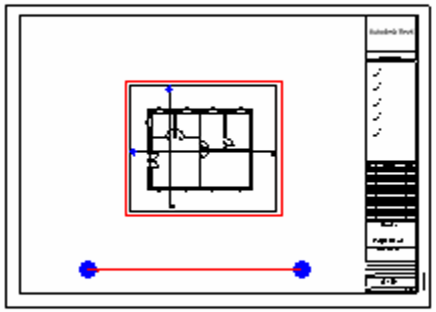
60. Set Level 1 current.



61. Select the crop region, and drag the blue grips toward the building.



62. The drawing sheet now reflects the smaller bounds established by the crop region.

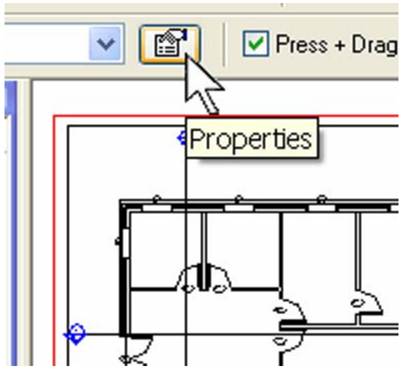


Relocate and resize the title mark to match the new bounds of the view.

63. Open the sheet.

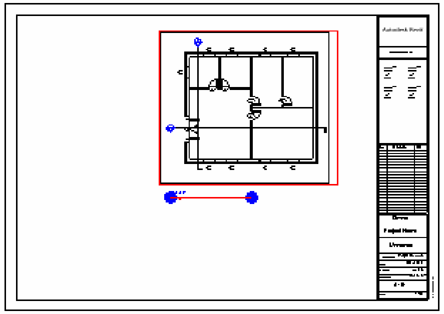
64. Select the viewport in the sheet.

65. Click the Properties button.



The properties of the viewport are linked to the properties of the view, in this case Floor Plan Level 1.

66. Change the scale of the viewport to 1:50.



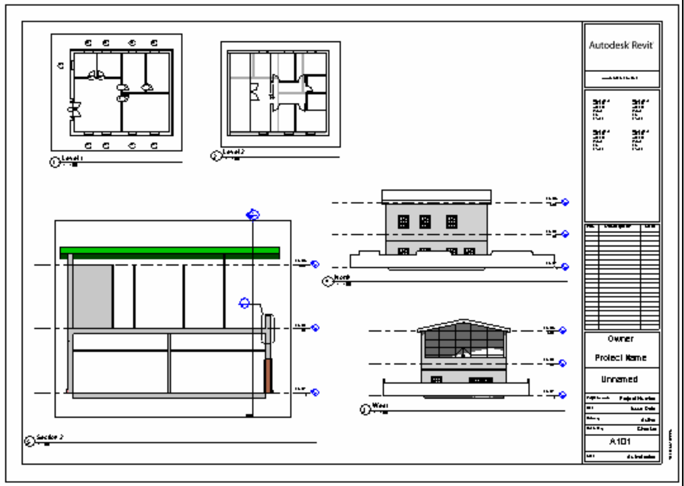
When the view scale changes back to 1:50, the size on the sheet changes.

If the title mark is selected as part of the viewport, you can just drag the ends of the title mark into position. Also use the Shape handle.

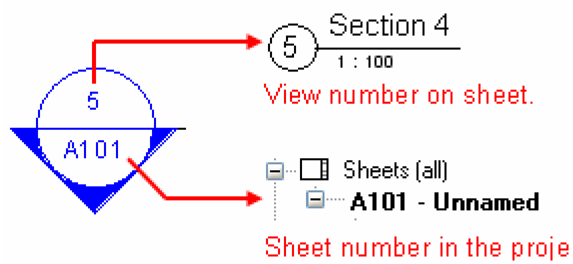
67. In the Project Browser right-click **Floor Plans – Level 1** and change **View Scale** parameter to **1:100**. Click **OK.**

68. Move the view on the sheet in the upper left.

69. In the same way, place elevations (west/north) and the Section 2.



Take a look at the symbol of the section line.



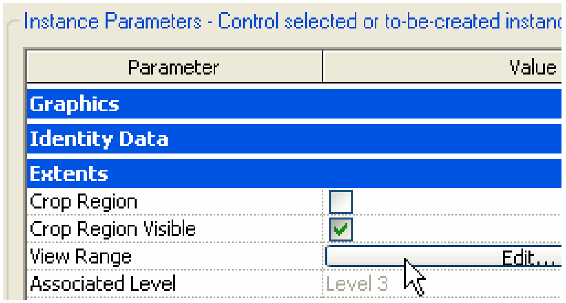
Autodesk Revit Building recognizes what sheet this section is positioned on and automatically fills in this information in the section bubble. Place the section on any other sheet, and the bubble updates. Section bubbles are families that can be customized to display other information.

Unit 5, Exercise B: Display Control of Materials

This exercise takes you through creating a material for the roof in the project from the last exercise.

Exercise Setup

1. Open file Unit 5b – Start.
2. Set Floor Plans : Level 3.
3. Right-dlick in the view, and choose View Properties.
4. Click the Edit button next to View Range.



5. Set the top offset to 10000.
6. Set the Cut plane offset to 10000.
7. Click OK to close the dialog boxes.

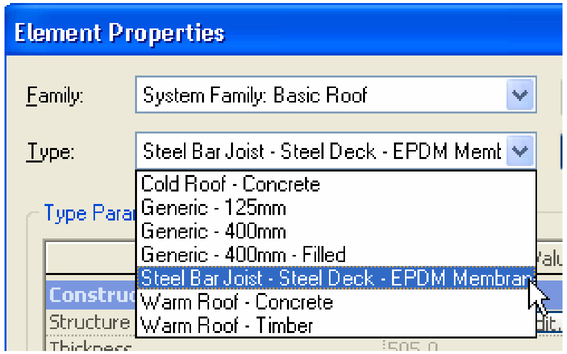
Create a New Roof Type

8. Click the roof and click the Properties button on the Options Bar.

9. In the Roof properties dialog box:

   a. Change the roof type to **Steel Bar Joist – Steel Deck - EPDM Membrane**.

   b. Click the Edit/New button.



10. In the Type properties dialog box:

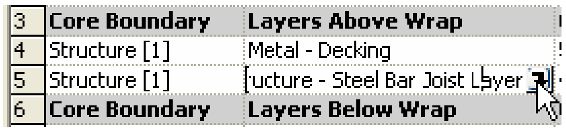
    a. Click the Duplicate button and name the new roof type **Steel Truss - Insulation on Sheathing with Metal Roof**.

    b. Click the Structure's Edit button.

11. In the Edit Assembly dialog box:

    a. Click the Preview button if you do not see a preview by default (a last used setting).

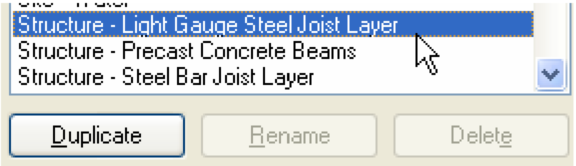
    b. Click Layer 5's material, and then click the browse arrow that appears.



12. Click the Light Gauge Steel Joist material.

13. Repeat for layer 4, changing the material from Metal – Deck to Wood – sheathing – Plywood.

14. Change the thickness of this layer to 19.



Do not close the Edit Assembly dialog box yet.

Create a New Material and Assign to the Roof Type

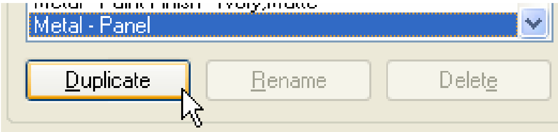
In this section you continue editing the assembly but create a new material on the fly.

All materials defined in the project file can be accessed by choosing Materials from the Settings menu.

In this example you access these material definitions directly from the Edit Assembly dialog box.

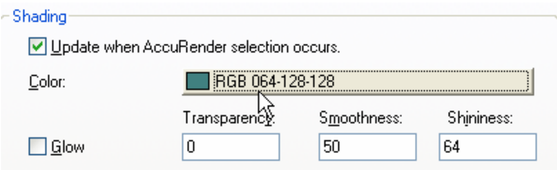
15. Click Layer 1's material, and then click the browse arrow that appears.

16. Click the Metal Panel entry, and then click the Duplicate button.

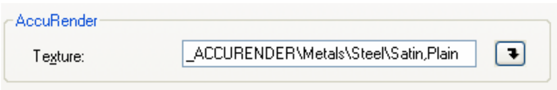


17. Enter **Metal – Roofing Standing Seam** as the name of the new material.

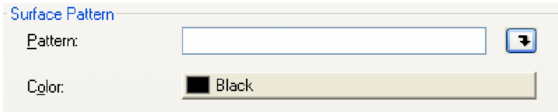
18. Click the Color button in the Shading portion of the Material dialog box, and pick a teal green color for the roof.



This color is used only when the view is set to shading or shading with edges.



There currently are no standing seam materials provided with the software. If you have a JPG, you can create an AccuRender material from the image file. For this exercise as we are not going to render this building, leave this material as you find it.



The Surface Pattern is empty for this material. There is no Standing Seam fill pattern either. You will create these patterns on the fly.

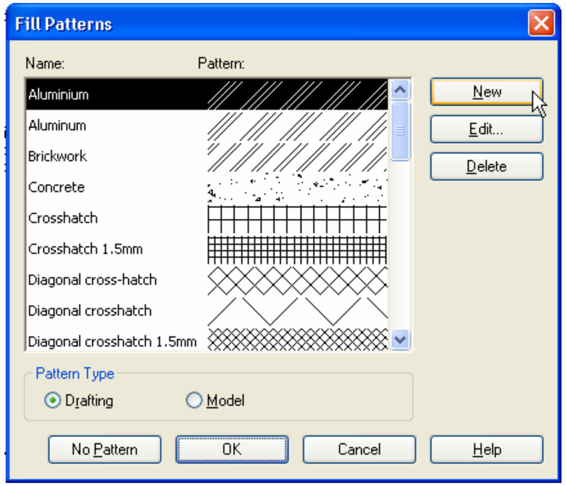
Create a New Fill Pattern for the Material

In this section you create a new fill pattern on the fly to use in the material you just created.

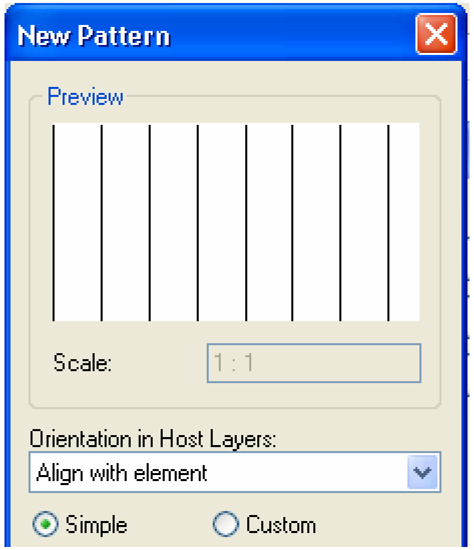
19. Click the Browse arrow to the right of the empty surface pattern field.

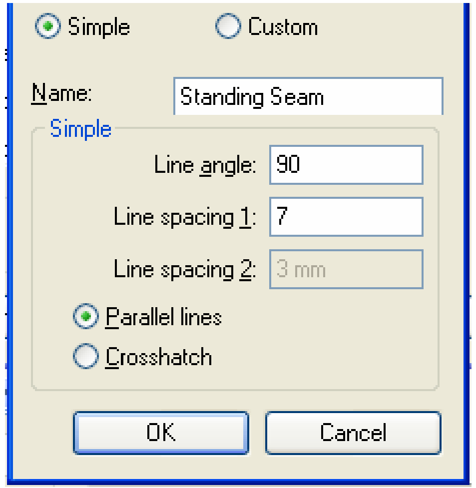
20. In the Fill Patterns dialog box:

  a. Click the **Drafting** radio button.
  b. Click the **New** button.

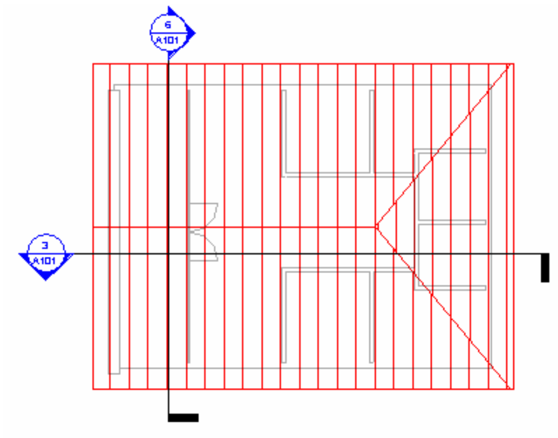


21. In the New Pattern Dialog box:
    a. Set Orientation in Host Layers to Align with Element.
    b. Click Simple radio button.
    c. Name the pattern Standing Seam.
    d. Set the line angle to 90.
    e. Set the line spacing to 7.
    f. Click the Parallel Lines radio button.

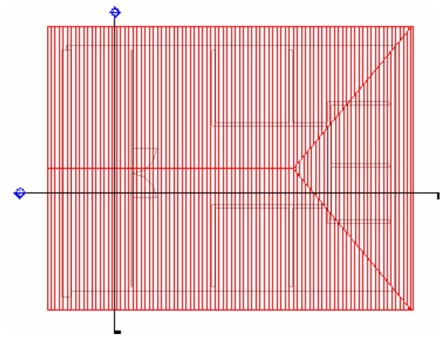




22. Click OK six time to close all dialog boxes and return to the drawing window.



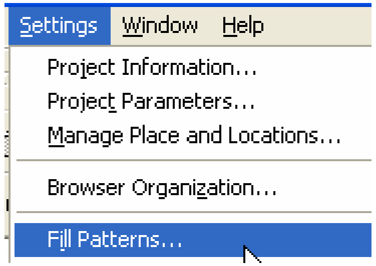
Drafting patterns change their scale depending on the view scale. Changing the scale of the view to 1:20 keeps the plotted distance between the lines consistent to 7mm.



Create a Model Fill Pattern and Assign to the Material

In this section you modify the material to use a new model fill pattern.

23. From the Settings menu, choose **Fill Patterns**.

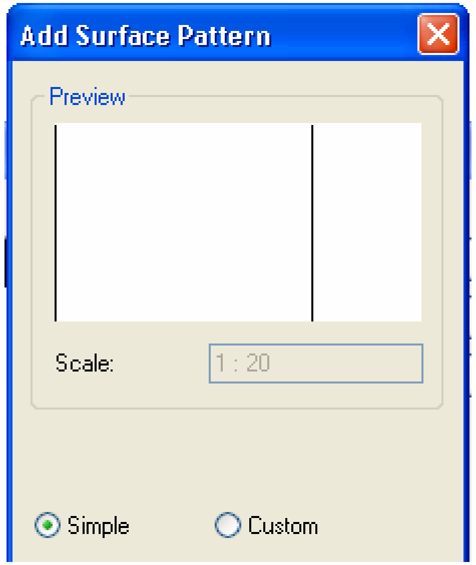


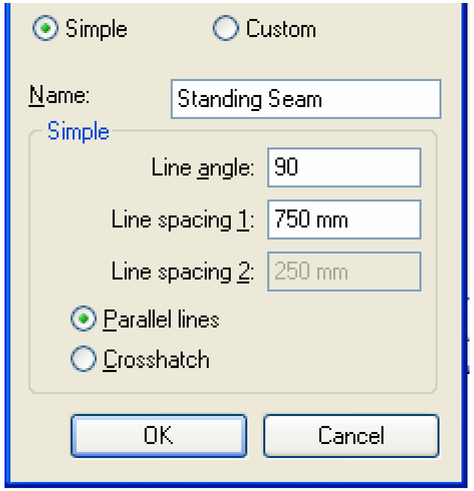
24. This time click the Model radio button, and then click the New button.

25. In the Add Surface Pattern dialog box set:

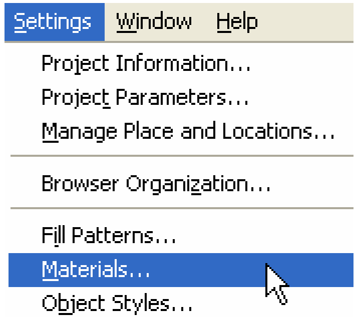
   a. Type = Simple
   b. Name = Standing Seam
   c. Line Angle = 90
   d. Line Spacing = 750 mm
   e. Parallel Lines

26. Click OK to close all dialog boxes.

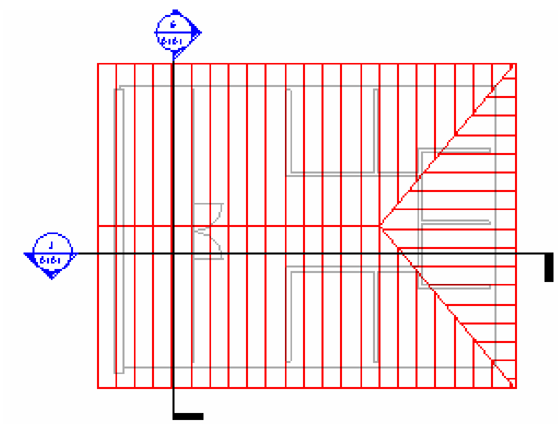




27. From the Settings menu, choose Material.



28. Set the new roof material's surface pattern to Standing Seam (Model).



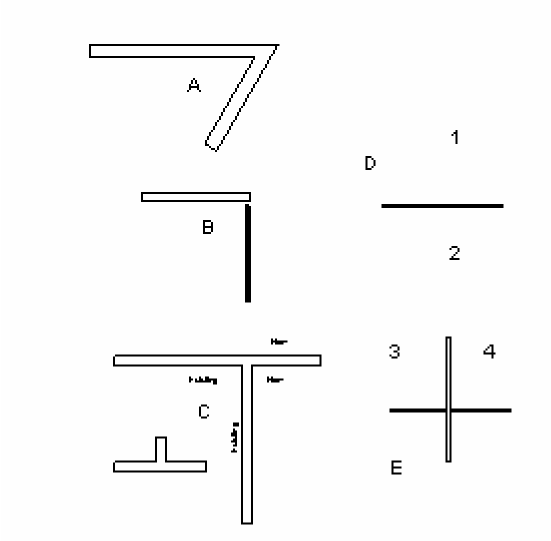
Model surface pattern dimensions are set by the fill pattern definition and do not vary by drawing scale.

Unit 5, Exercise C: Fine-Tuning Wall Cleanup and Display

This exercise illustrates some of the different display and cleanup control you have over walls in your Revit Building project.

Exercise Setup

1. Open file Unit 5c – Start. Open Floor Plan Level 1.
2. Verify the view's detail level is set to Coarse.



Set Fill for Coarse Level Display

Revit Building walls have a separate control for the display detail level "Coarse". This coarse fill pattern and color enable you to poche the entire width of the wall regardless of the number of components in the wall.

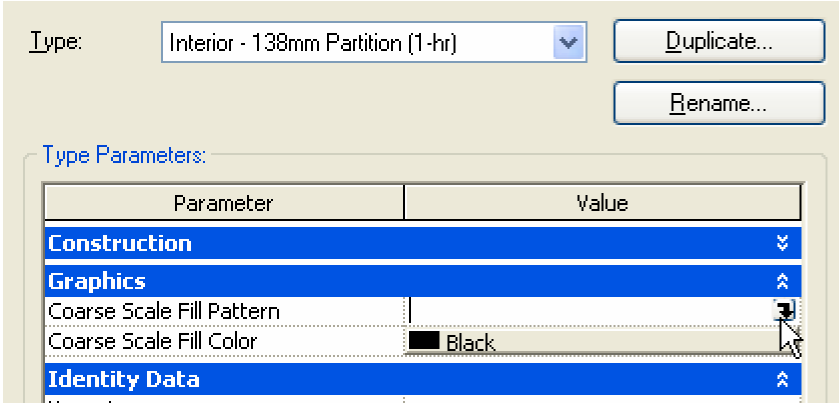
This setting is a type parameter for the wall.

3. Select any wall, and open its Properties dialog box.

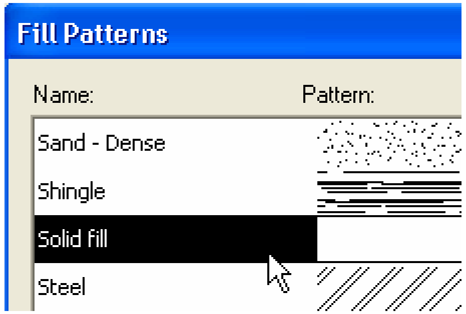
4. Click the Edit/New button to access the wall's type properties.

5. Verify that the coarse scale fill color is Black.

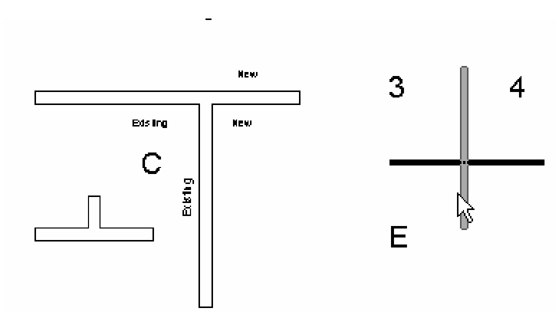
6. Click in the Value field of the Coarse Scale Fill Pattern parameter, and click the browse arrow that appears in the field.



7. Click Solid Fill for the fill pattern.



8. Click OK two times to close all dialog boxes and return to the drawing window.

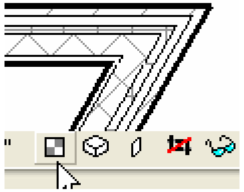


Because this is a type parameter, you need to repeat this process for all wall types used in the project.

Global Control of Linework Display of the Walls: Object Styles

Revit Building walls have a separate control for the display detail level "Coarse". This coarse fill pattern and color enable you to poche the entire width of the wall regardless of the number of components in the wall.

9. Set the View Detail level to Medium.



10. From the Settings menu, choose Object Styles.

11. On the Model Objects tab of the Objects Styles dialog box, scroll down the list of objects and expand the Walls category.

The Object Style dialog box controls the lineweight, color, and linetype.

This is also the location where you can assign materials to obects.

In all cases if the object is set to "By Category" for any of these parameters, these are the values referred to.

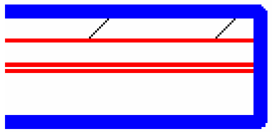
12. Change the Walls Cut Line color to Blue and the Common Edges to Red.

Category	Line Weight		Line Color
	P...	Cut	
Walls	2	5	Blue
Common Edges	2	2	Red
Hidden Lines	2	2	Black
Wall Sweeps - Cornice	1	5	Black
Windows	2	2	Black

Changes you make in the Object Styles dialog box are global and apply to all views.

13. Click OK to return to the drawing window.

The object styles are now applied to all wall types in the project. The Wall's **Cut** (pen 5 and blue) refers to the outer edge of the wall. The Wall's subcategory **Common** refers to the lines common to the layers within the wall.



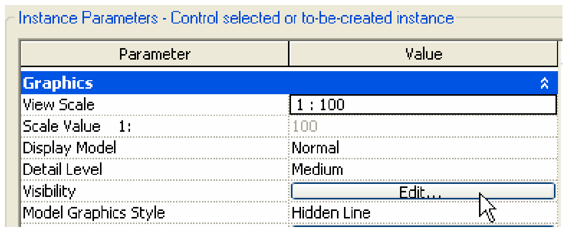
Override of Linework Display of the Walls: View Visibility/Graphics by Category

Each view has its own override to the global object style settings. A couple of the previous exercises have used this control to manipulate how objects are displayed in specific views.

The Visibility/Graphics dialog box also holds overrides to the wall component display graphics.

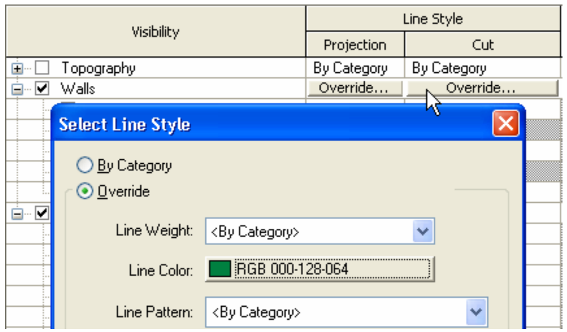
14. Open the View properties for Floor Plans: Level 1.

15. Click the Edit button for the Graphics Visibility.

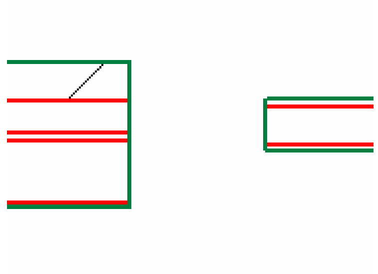


16. Click the Walls Cut Line style and set the override line color to a dark green.

17. Click OK to close all dialog boxes and return to the drawing window.

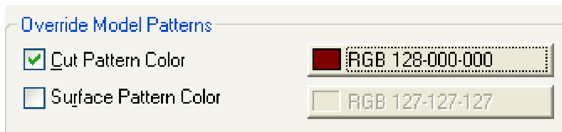


These changes are only for the current view.

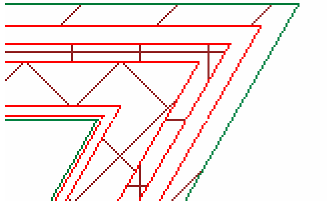


18. Return to the view's Visiblity/Graphics override dialog box, and on the Model Objects tab set the Cut Pattern Color to dark red.

19. Click OK to return to the drawing window.

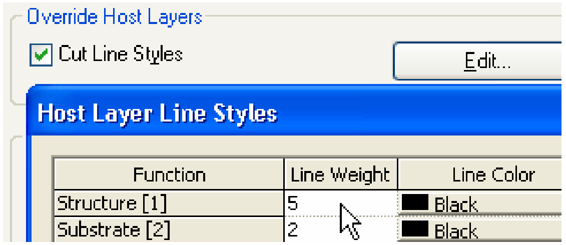


The override applies to all cut patterns for all layers in the wall type.

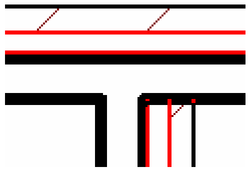


Override of Linework Display of the Walls: View Visibility/Graphics and Cut Line Styles

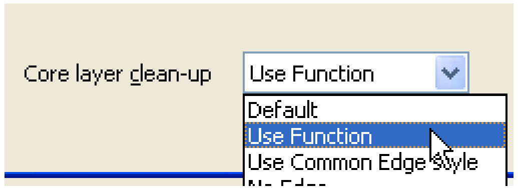
20. Return to the view's Visiblity/Graphics override dialog box.
    a. Select the Cut Line Style check box.
    b. Click the Edit button.
    c. Set the Structure[1] to Line Weight 5.
21. Click OK to close all dialog boxes and return to the drawing window.



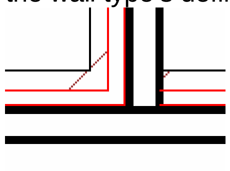
Any layer in the wall type definition assigned to the structure layer now has the wider (pen 5) lineweight assigned to it.



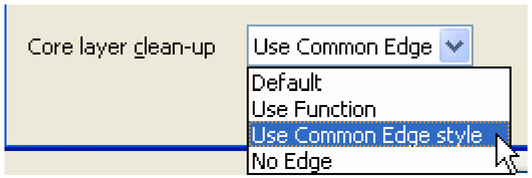
22. Return to the view's Visiblity/Graphics override dialog box.
    a. Click the Cut Line Style's Edit button.
    b. Set Core Layer Clean-up to Use Function.
23. Click OK to close all dialog boxes and return to the drawing window.



This setting affects only the layers within the core of the wall type's definition.

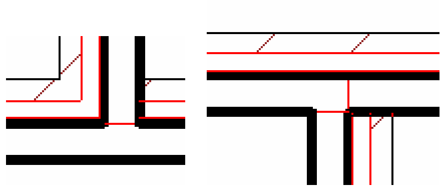


24. Return to the view's Visiblity/Graphics override dialog box.
    a. Click the Cut Line Style's Edit button.
    b. Set Core Layer Clean-up to Use Common Edge Style.
25. Click OK to close all dialog boxes and return



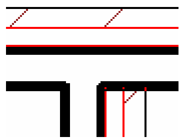
This setting affects only the layers within the core of the wall type's definition. Joins between individual walls are shown, but using the common edge style graphic line.

to the drawing window.



26. Repeat the step and set Core Layer Clean-up to No Edge.

No edges are shown at the core cleanup condition between joins.

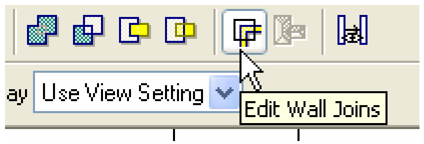


Wall Cleanup and Joins

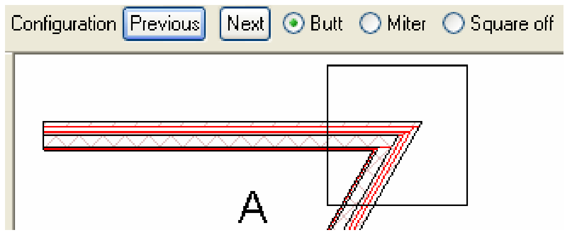
Revit Building walls automatically clean up as they are added to the project. This section of the exercise guides you through control of some special conditions.

27. Zoom into Condition A in the project.

28. Click the Edit Wall Joins tool on the toolbar.

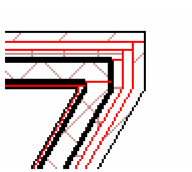


29. Hover your cursor over the intersection of the walls until you see a square appear around the intersection. Click that area.

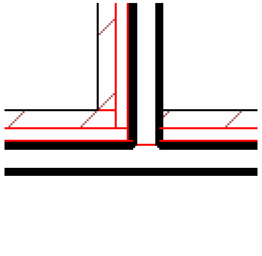


Once an intersection has been selected to edit, the configuration control appears on the Options Bar. The Next and Previous buttons cycle through various ways this intersection can be cleaned up.

30. Click the Square Off radio button and then the Next button until you cycle through to the solution shown at right.

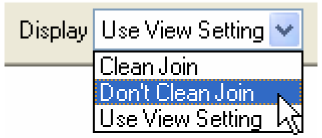


31. While Still in the Edit Wall Joins mode, click the intersection of the inverted T at condition C.

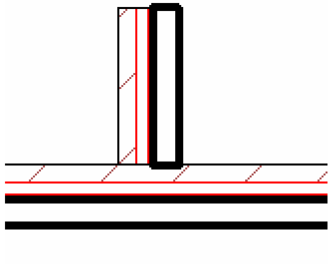


This illustrates a condition that might happen a new wall abuts an existing wall. In this case you do not want the core penetrating through the existing (horizontal) wall.

32. On the Options Bar, use the Display drop-down to select Don't Clean Join.



The join is disallowed, and the wall does not cut through the existing brick face.

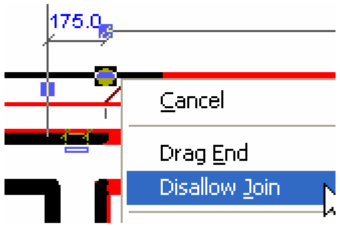


33. Click the Modify tool to exit the Edit Wall Joins Function, and zoom into the other intersection at condition C.

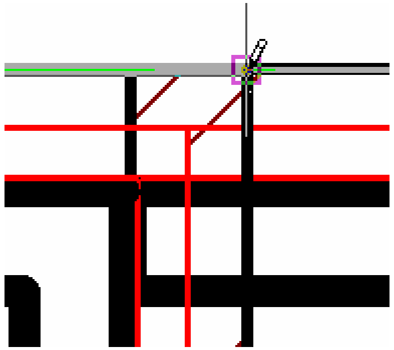
This condition is similar to the last; however, there are three walls that make up the intersection. You cannot disallow all joins because you still want the two existing walls to clean up.

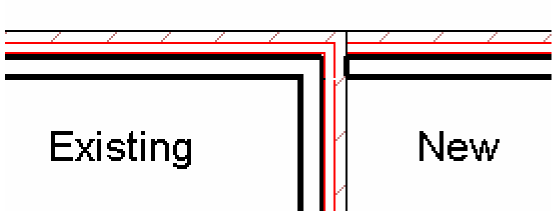
34. Click the right wall of the three walls at this intersection, and right-click on the blue end grip of this wall.

35. Choose Disallow Join from the context-sensitive menu.



36. Drag the wall end to the exterior face of the existing brick.



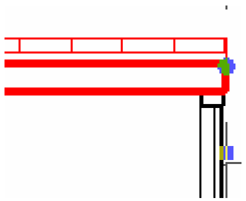


Wrap the End of the Wall

You have control over the wrapping behavior of each of the components in a wall type definition.

37. Zoom into Condition B in the project.

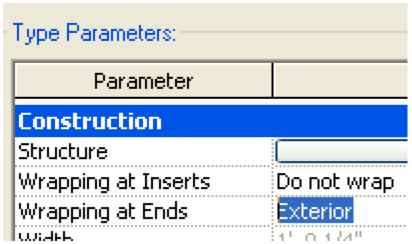
38. Open the type properties of the horizontal wall.



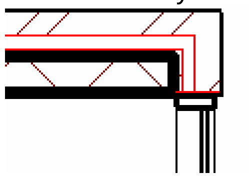
In this case the brick does not wrap around the end of the wall to provide closure to the curtain wall.

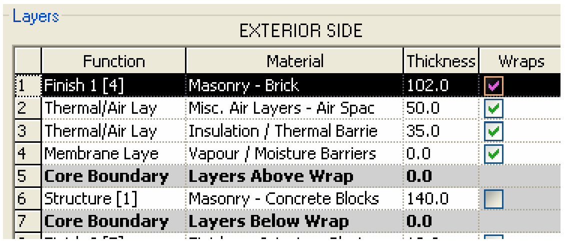
39. Change Wrapping at Ends to Exterior.

40. Click OK to close all dialog boxes and return to the drawing window.



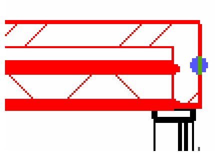
The exterior layers now wrap the end of the wall.





Within the Structure of the wall type, you can control which layers wrap.

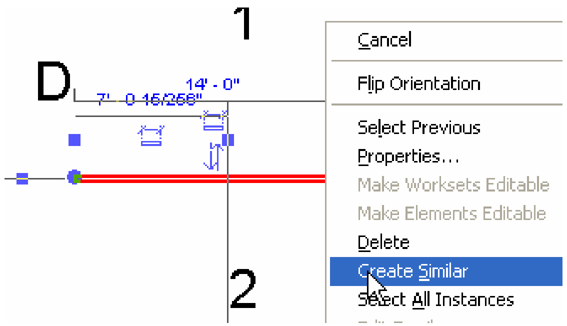
1	Finish 1 [4]	Masonry - Brick	102.0	☑
2	Thermal/Air Lay	Misc. Air Layers - Air Spac	50.0	☐
3	Thermal/Air Lay	Insulation / Thermal Barrie	35.0	☐
4	Membrane Laye	Vapour / Moisture Barriers	0.0	☐
5	**Core Boundary**	**Layers Above Wrap**	**0.0**	
6	Structure [1]	Masonry - Concrete Blocks	140.0	☐



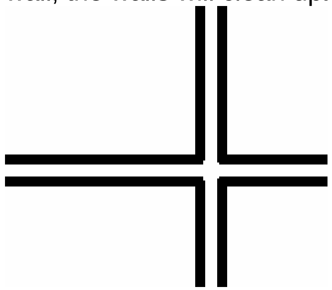
Join Geometry

You have control over the wrapping behavior of each of the components in a wall type definition.

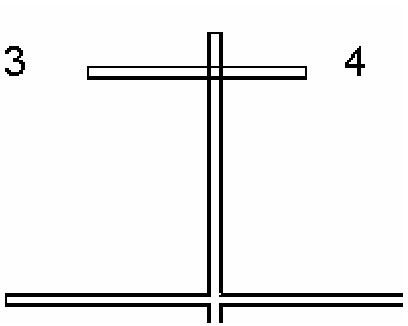
41. Right-click the wall at condition D, and choose Create Similar.
42. Draw a vertical wall from the number 1 to 2.



As long as the walls do not cross near the end of a wall, the walls will clean up.

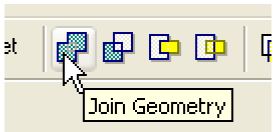


43. Right-click the wall at condition e, and choose Create Similar.
44. Draw a vertical wall from the number 3 to 4.

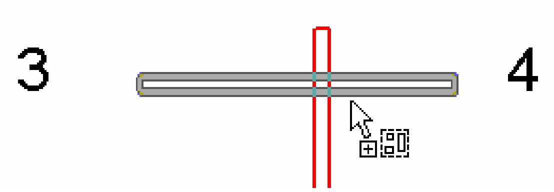


If crossing walls do not clean up, you can use the join geometry tool to force the cleanup.

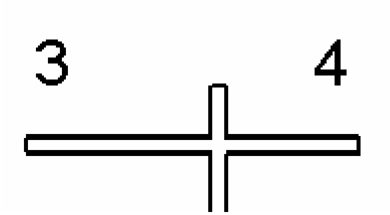
45. Click the Join Geometry tool on the toolbar.



46. Click one of the walls, then the other.



The two walls now clean up with each other.

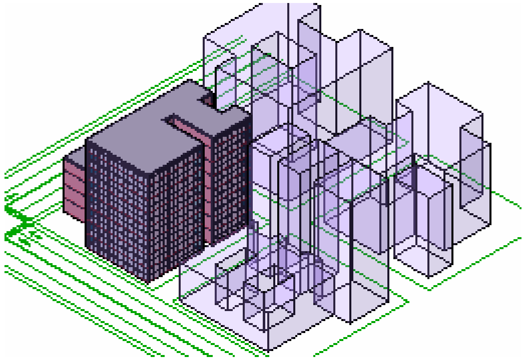


Unit 5, Exercise D: Sun and Shadow Studies

This exercise leads you through using the sun and shadow features of Revit Building.

Exercise Setup

1. Open file Unit 5d – Start.
2. Set the 3D Views : {3D} current.
3. Click the Show Mass tool on the toolbar.



Duplicate the 3D View

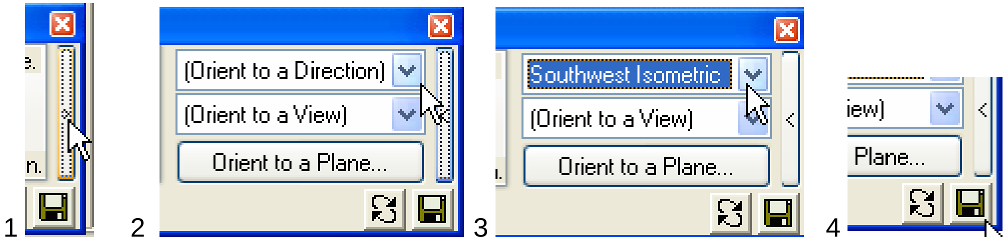
Create a new view for the sun studies.

While not required, you could do the sun study in the 3D view. Because many of the settings for the sun studies are view specific, creating a view specifically for the sun study is a good idea.

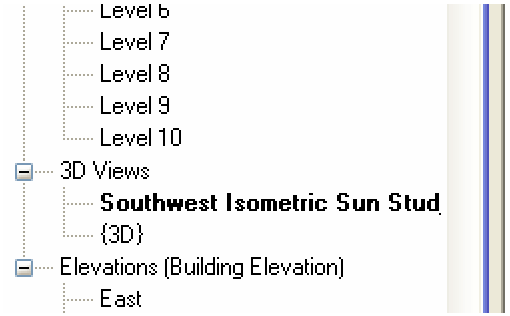
4. Click the Dynamically Modify View tool.

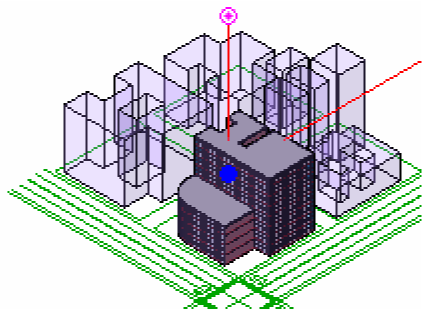
5. In the Dynamic View dialog box:

   a. Click the Expansion bar at the right of the Dynamic View dialog box.
   b. Click Orient to a Direction, and click Southwest Isometric.
   c. Click the Save icon.



6. Name the new view Southwest Isometric Sun Study.





Set the Sun Study Parameters

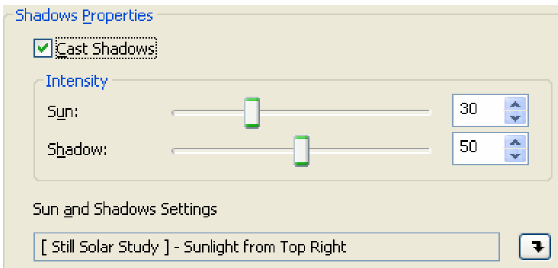
The parameters that drive the sun study's function are held in the advanced model graphics for the view.

You can access the advance model graphics either through the view properties or via the context-sensitive menu of the drawing area window, as shown here.

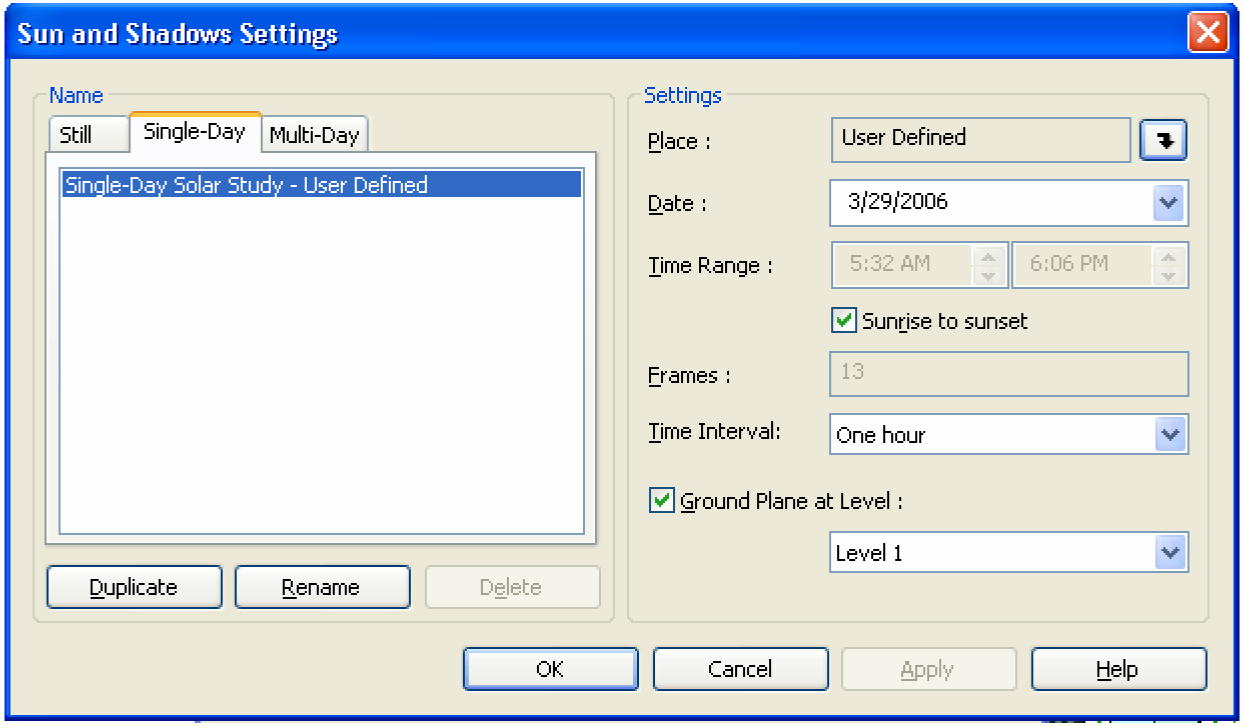
7. Click the Shadows pop-up menu of the drawing window, and then click Advanced Model Graphics.

8. In the Advanced Model Graphics dialog box:

   a. Select the Cast Shadows check box.
   b. Click the Sun and Shadows Settings arrow.



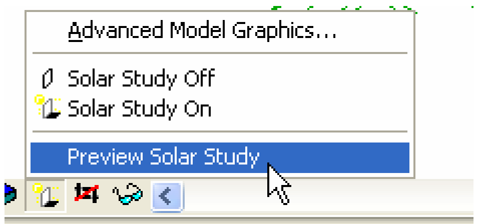
9. In the Sun and Shadow Settings dialog box:
   a. Click the Single-Day tab.
   b. Change the place settings, date, and time interval to your preferences.
   c. If you do not have a toposurface in the model (discussed in chapter 12), leave the Ground Plane at Level check box selected.
10. Click OK to close all dialog boxes and return to the drawing window.



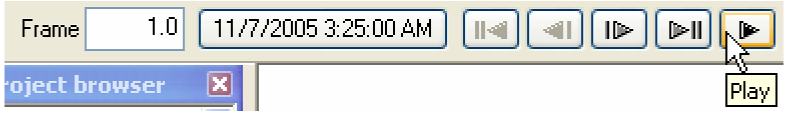
Preview the Sun Study in the View

With the sun study parameters set, you are now ready to view the sun and shadows cast on the building model.

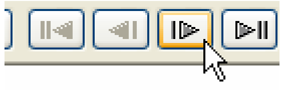
11. Click the Shadows pop-up menu of the drawing window.
   a. Choose Preview Solar Study.



12. On the Options Bar, click the Play button.



The sun study plays through the day, cycling at the interval specified in the sun and shadow settings.

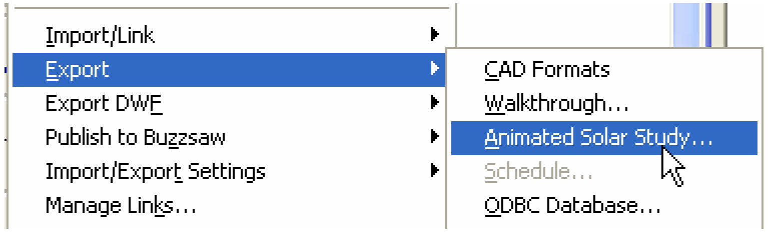


Click the Next Frame button to manually walk through the study.

Export the Sun Study to an AVI File

With the sun study parameters set and previewed, you are ready to export the sun study to a movie format file.

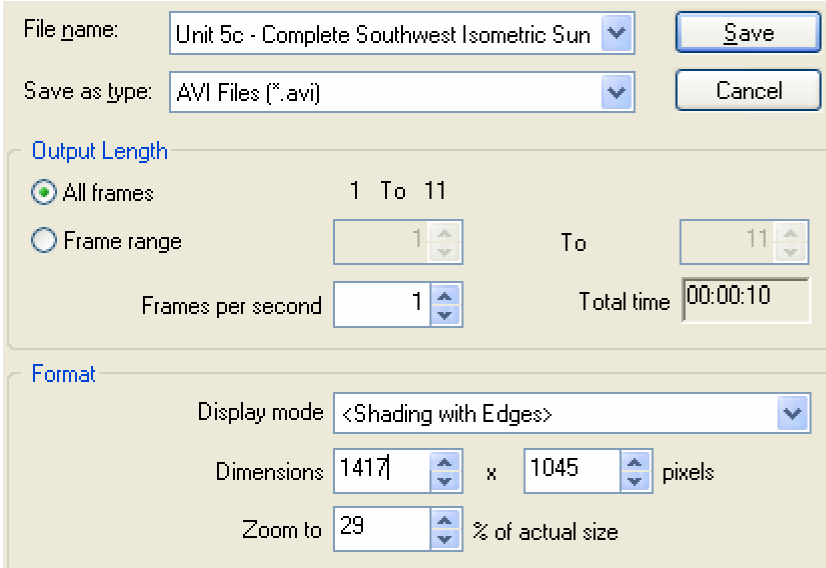
13. From the File menu, choose Export>Animated Solar Study.



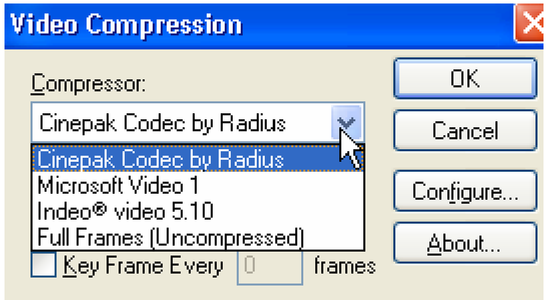
14. In the Save As dialog box, set the following:

   a. Name the AVI file.
   b. Change the frames per second to 1 as we have left the default at 1 frame per hour. Having 15 frames per second would make for a very short AVI file!
   c. Adjust the format display mode and dimensions to your preferences.

15. Click the Save button.



16. Change the compression codec if you want, and click OK.



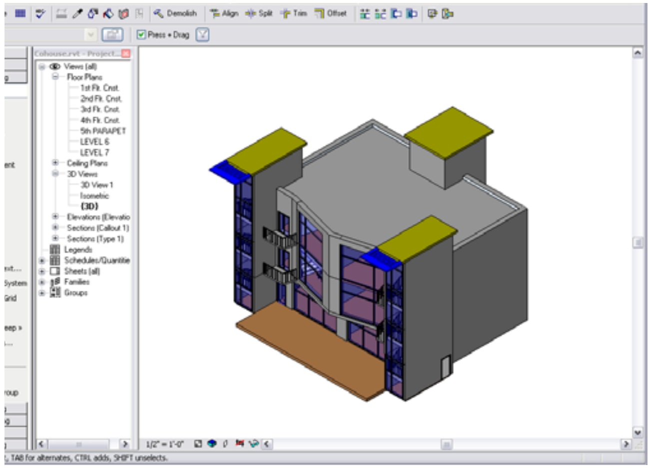
The compressors available depend on what software is installed on your machine. Full Frames is the most compatible compression method, but also produces the largest file.

Importing an Autodesk Revit Building Model into Autodesk 3ds Max

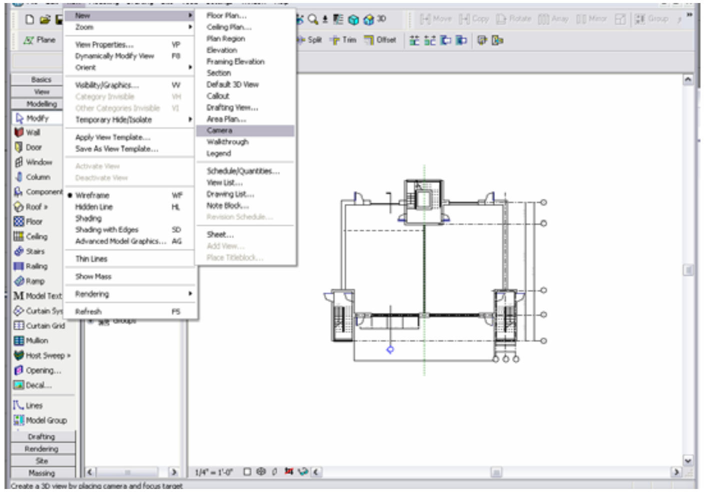
The following exercise describes how to import an Autodesk Revit Building model into Autodesk® 3ds Max® software for visualization.

Set up Your Model for Export

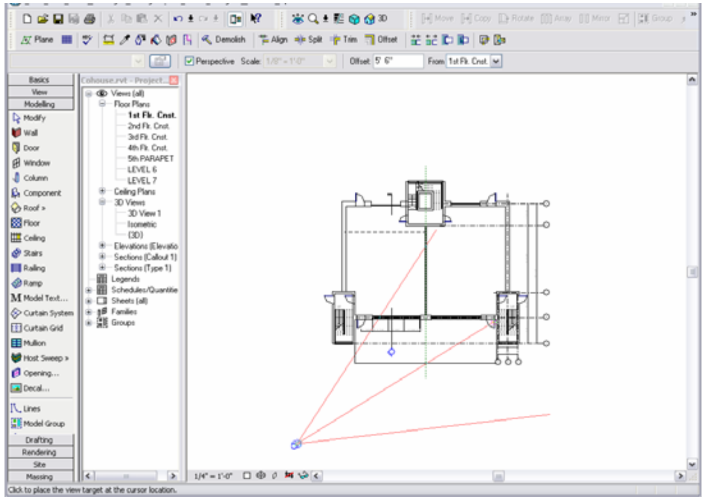
1. Before exporting your model, find the appropriate 3D view. Either use the default 3D view, or create your own by placing a camera.



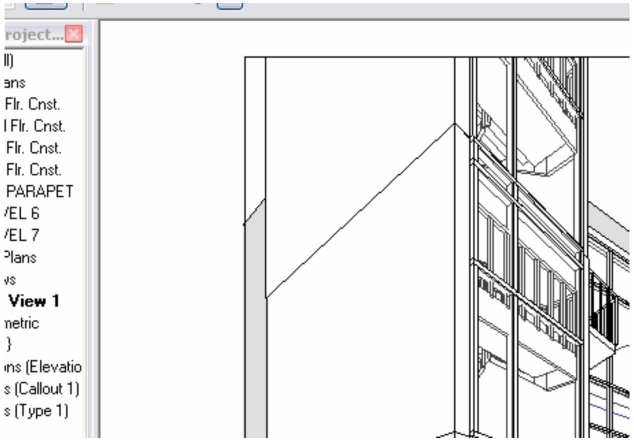
2. If you prefer to set up a camera, simply go to a plan view. From the **View** menu, choose **New>Camera**.



3. Place the camera to create the appropriate view.



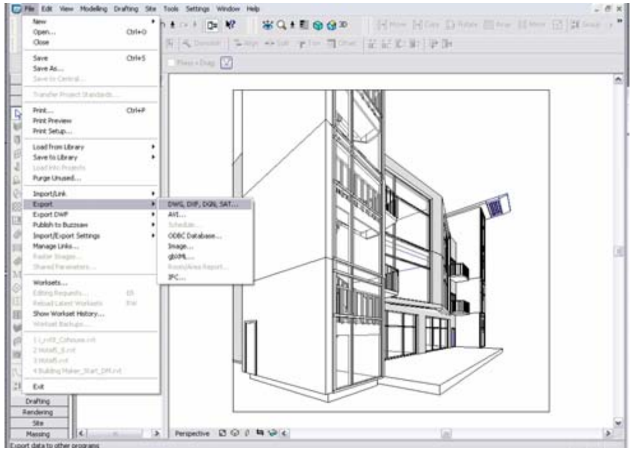
4. With the camera in place, your 3D view is now ready for export.



Export Your Model

Autodesk Revit Building exports data in a variety of file formats, including DWG™ format.

5. To export your design to the DWG format, from the **File** menu, choose **Export>DWG, DXF, DGN, SAT**.

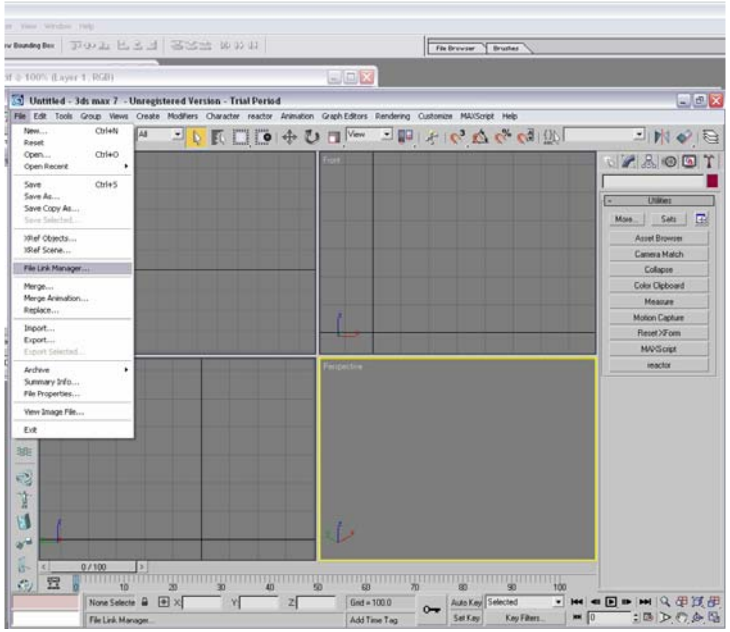


6. Choose a location to save your exported model, accept the default values, and click OK. When exporting a camera view, you see an alert indicating that the entire model, including everything not seen in the current view, will be exported. Click OK.

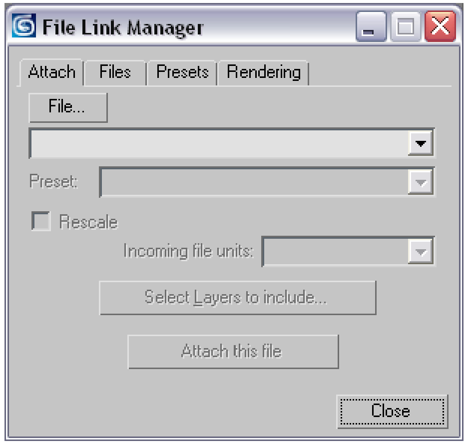
Link Your Model to 3ds Max

You can either import DWG files into a 3ds Max session or link them. Linking a DWG file to a 3ds Max session gives you the advantage of making subsequent changes in Revit Building and reloading them, via an exported DWG file, into 3ds Max without any data loss.

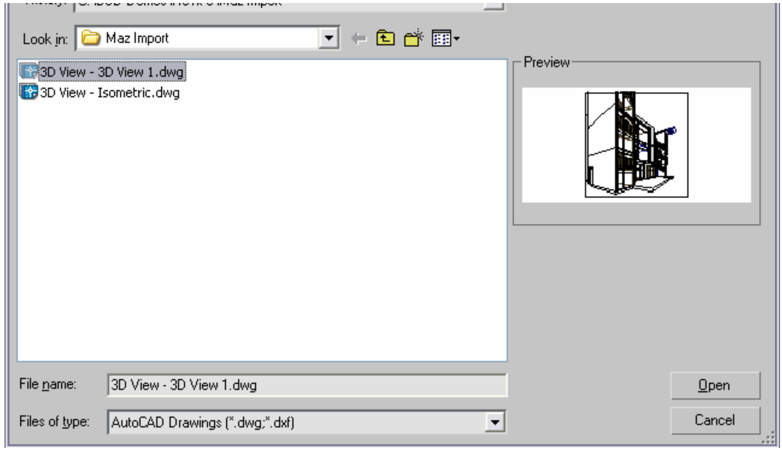
7. To link the DWG file, from the **File** menu, choose **File Link Manager**.



8. When the File Link Manager dialog box appears, click the **File** button on the **Attach** tab and browse to the exported DWG file.



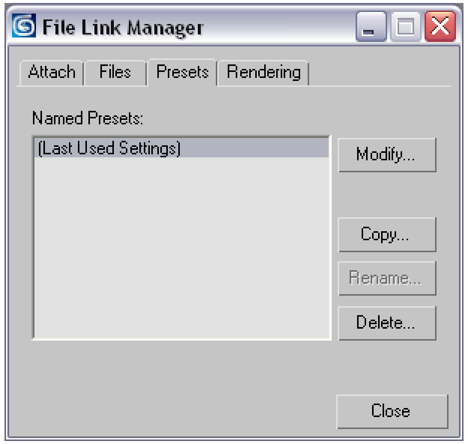
9. Select the DWG file and click Open.



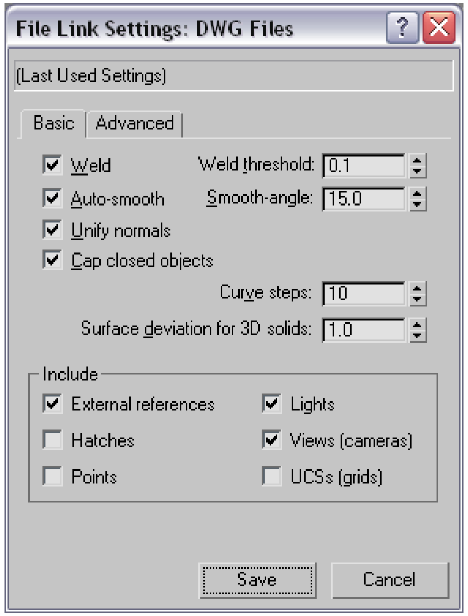
Make sure that any cameras created in Revit Building are also available in 3ds Max.

10. In the File Link Manager dialog box, click the Presets tab and modify a **Named Preset**.

11. If you do not want to modify an existing preset, copy it and then modify it.

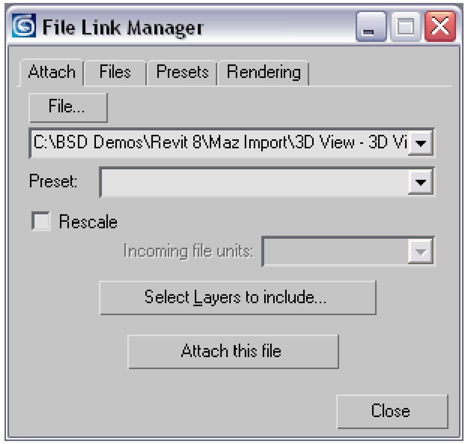


12. There are several options on this tab. To ensure that your Revit Building cameras are available in 3ds Max, make sure the **Views** check box is selected.

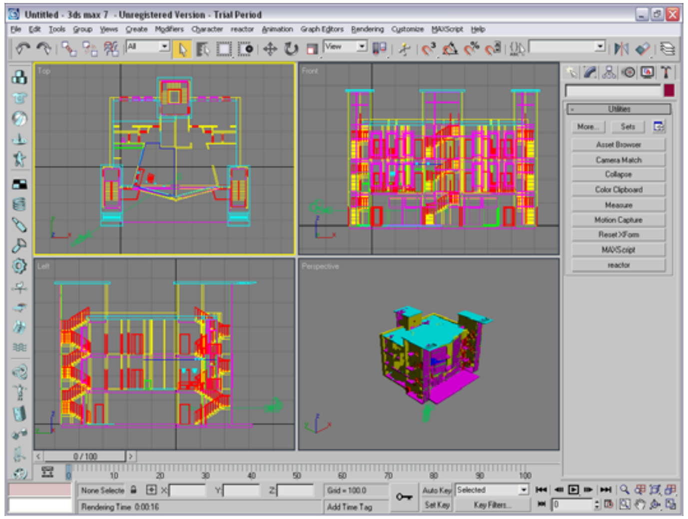


13. Save your modifications and then go back to the Attach tab in the File Link Manager dialog box.

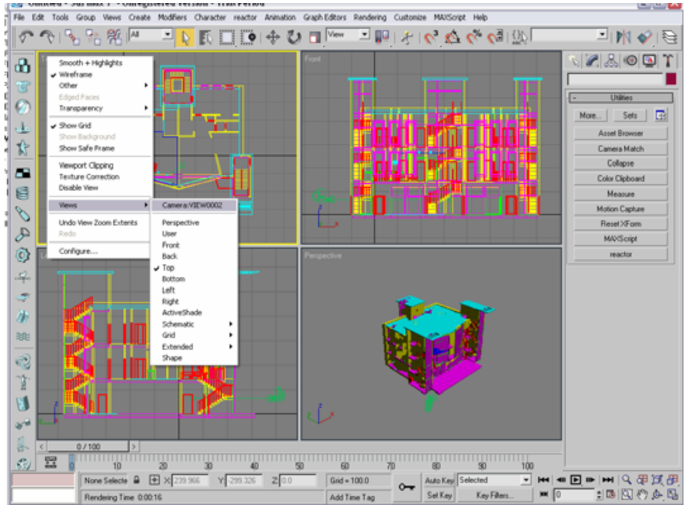
14. Click the **Attach This File** button to load the DWG file into 3ds Max. Then click Close.



15. Your model is now loaded into 3ds Max.



16. Once the model is loaded, you can change the view to one of the camera views created in Revit Building by simply right-clicking the view name in the upper-left corner of the viewport and choosing Views>Camera: View # (where # represents the number of the Revit Building camera).



Your Autodesk Revit Building model is now ready for visualization in 3ds Max!

Units 6–8

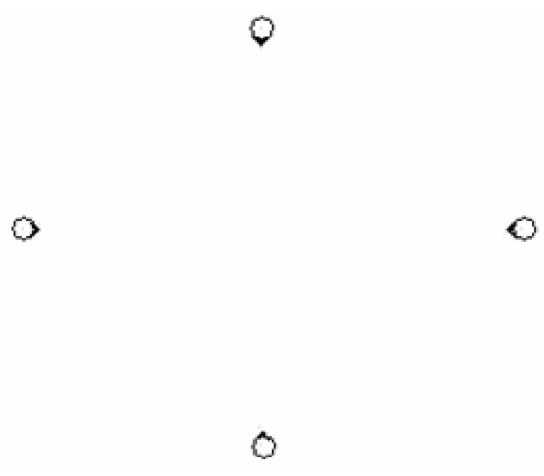
Theory: Design Constraints

Autodesk Revit Building: Levels, Reference Planes, and Grids

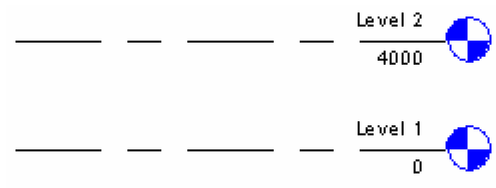
This unit covers the basics of design constraints. You create gridlines, and then use the array tool and look at the constraint tools it offers. You then add walls, constraining them to the gridlines. In the second part of this unit, you create a roof by extrusion that is constrained to reference planes.

Create Gridlines in a New Project

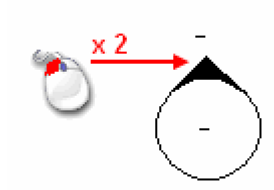
1. From the **File** menu, choose **New**>**Project**.
2. Click the **Browse** button and navigate to the folder that contains **Workbook Metric Template.rte** provided with the data set.



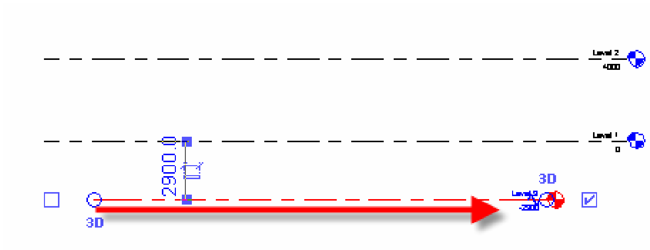
3. In the Project Browser, open **Elevations South**.



Double-click the black triangle of an elevation symbol in the project to automatically open the corresponding elevation.

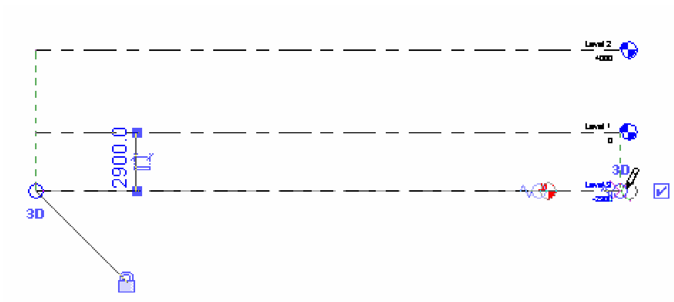


4. On the **Basics** Design Bar, click **Level** and click two points below **Level 1**. It does not matter where you click (use the image as a guideline).



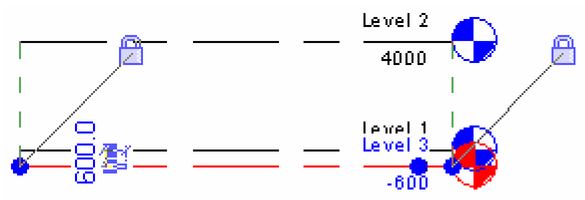
To place a new level you must be in elevation view or in a section view.

5. On the **Basics** Design Bar, click **Modify** and select the level you've just added.
6. Drag the blue dot on the left until it is aligned with the existing ones.
7. Do the same for the blue dot on the right.

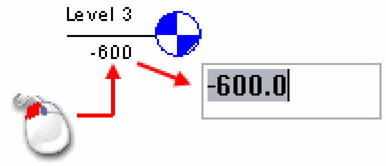


Autodesk Revit Building helps you here: As soon as the points are aligned, Revit Building displays a green dashed line along these points. You then see a blue padlock symbol, which indicates that all the points are locked together. If you move one, all the others follow the move.

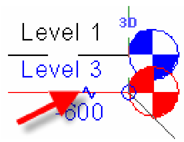
8. With the level still selected, click the text of the temporary dimension of this **new level**. Change the value to **600mm**.



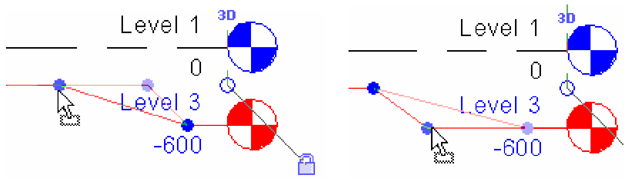
If you know the absolute elevation of a level, you can type it directly by clicking the text that is below the level line.



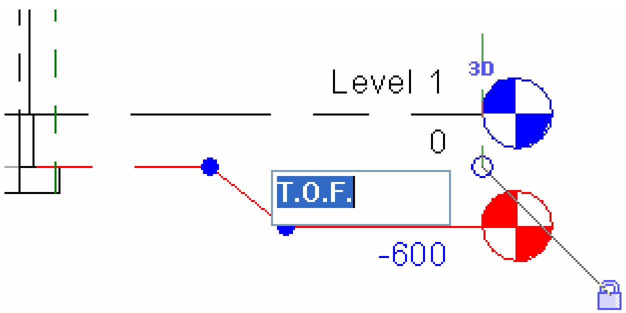
9. Click the squiggle grip to offset the mark from Level 1.



10. Drag the blue circle grips to adjust the leader away from the mark.



11. Click the name of the new Level (**Level 3**) and change this name to **T.O.F.** (Top of Foundations). Revit Building asks if you want to rename the corresponding view. Click **Yes**.



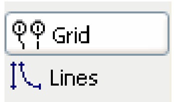
Each time you create a level, a view for that level is automatically created by Revit Building. If you don't want a view for a level, clear Make Plan View on the Options Bar.

You can choose to rename the level from the Project Browser by right-clicking this view and choosing Rename from the context-sensitive menu.

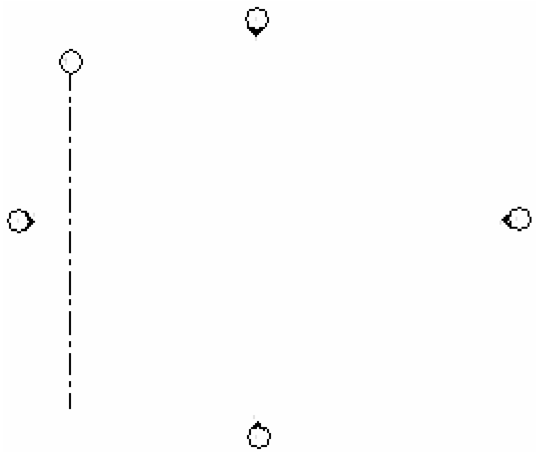
Add Grid Lines

Gridslines and level line marks behave much the same way and have similar controls for the marks.

12. From the Project Browser, open **Floor Plans Level 1**.



13. On the **Basics** Design Bar, click **Grid**.
14. Click two points to place the first vertical gridline. Pick from bottom to top, or south to north.



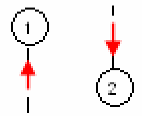
15. On the **Basics** Design Bar, click **Modify** and select the gridline in the project.

16. On the **Edit** toolbar, click **Array**.

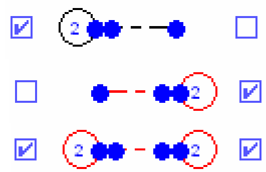
On the Options Bar, set the following:
a. Keep **Linear**.
b. Keep Group and Associate selected.
c. In the **Number** box type **5**.
d. Keep Move to 2nd.

17. Click the gridline, move your cursor to the right, and on your keyboard type **6m** and press

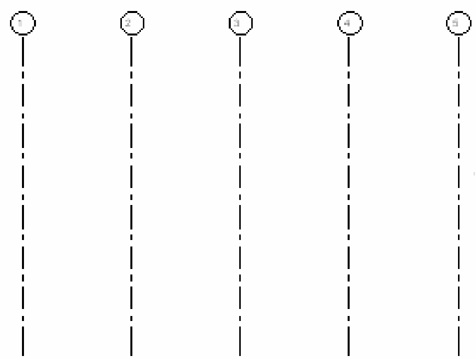
The direction used to draw the gridline defines the side where the bubble is attached.



If you draw it in the wrong direction, you can use the check box that appears at the end of the gridline when the gridline is selected.



Note: Same applies to level markers.



When you've finished the array, you can

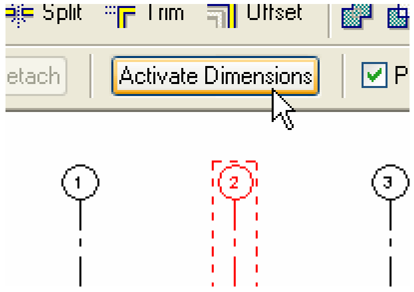
Enter.

easily change the number of copies. If necessary, click an element in the array to display the number of copies.

Adjust Arrayed Elements

Modifying a dimension between arrayed elements will modify all arrayed elements.

18. Click **Gridline 2**, and on the Options Bar, click **Activate Dimensions**.

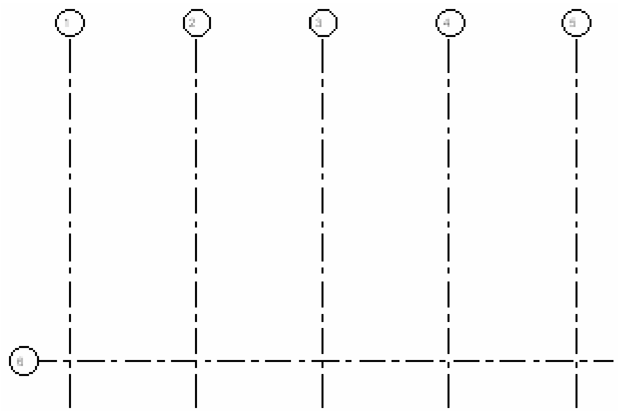


19. Click the dimension that appears, and type 20 to enter 5.7m for the distance

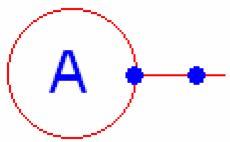
The entire grid system adjust to the new dimension.

Add Horizontal Grids

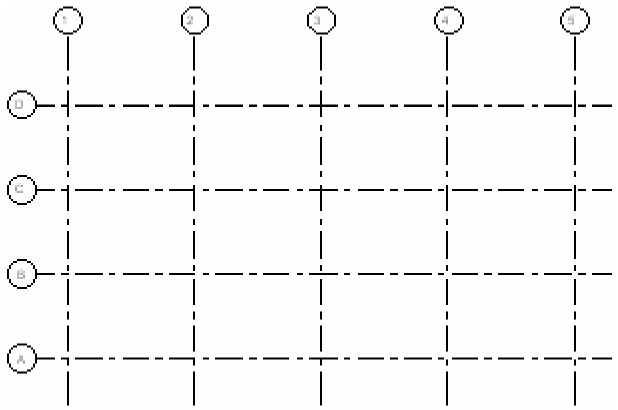
20. On the **Basics** Design Bar, click **Grid**.
21. Click two points to place the first horizontal gridline from right to left.
22. Press **Esc** twice.



23. Zoom around the bubble of the horizontal gridline.
24. Select the gridline. Click the text in the bubble, change the value to **A,** and press **Enter**.



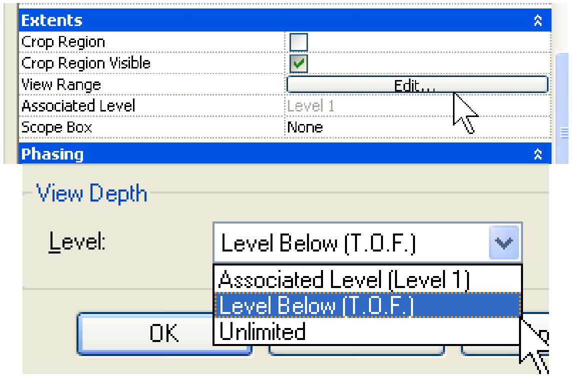
25. Create an **array** with this gridline. Clear the Group and Associate check box. The distance between two lines should be **4m** and the number of copies set to **4**.



Arrays in Autodesk Revit Building are powerful. You can move one element in the array and all the others move accordingly. Note, however, that this occurs only if you have selected Group and Associate from the Options Bar before array creation.

Add a Foundation Wall

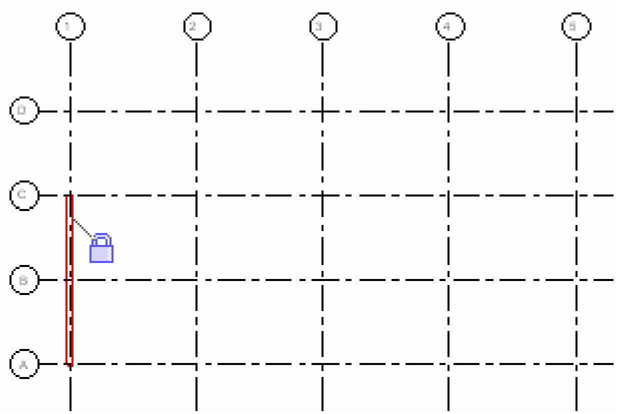
26. Right-click in the view, and choose **View Properties** from the context-sensitive menu.
27. In the **Element Properties** dialog box, click **Edit** next to **View Range**.
28. From the **View Depth** drop-down list, select **Level Below**.
29. In the **View Range** dialog box, click **OK**.
30. In the **View Properties** dialog box click **OK**.



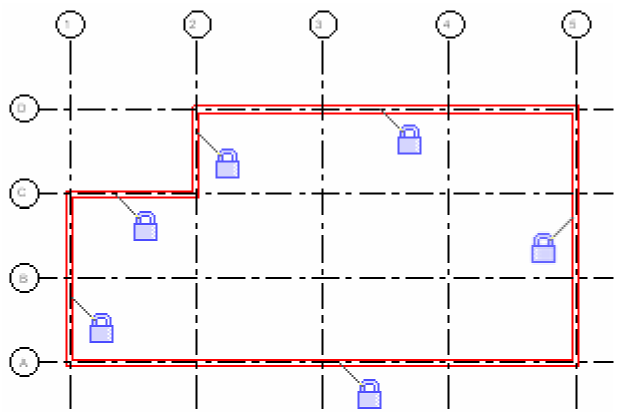
The foundation wall is positioned below the current level. If you don't change view depth, you cannot see the new wall that you are going to add.

31. On the **Basics** Design Bar click **Wall**.
32. On the Options Bar:
    a. Select **Basic Wall: Foundation - 300mm Concrete**.
    b. Set **Depth** to **Level T.O.F**.
    c. Check that alignment is set to **Wall Centerline**.
    d. Clear **Chain**.

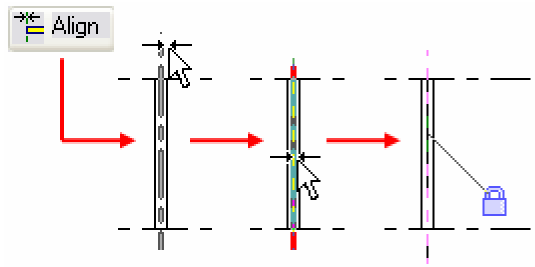
33. Draw a first wall from intersection between lines **1-A** and intersection **1-C**. Click the lock symbol to lock the wall with the gridline.



34. Using the image as a guide, add **five** walls. All of them must be locked with the corresponding gridline.



If you've used the Chain option, you probably don't see the padlock symbol. Use the Align tool to lock the relationship between the gridline and the wall.

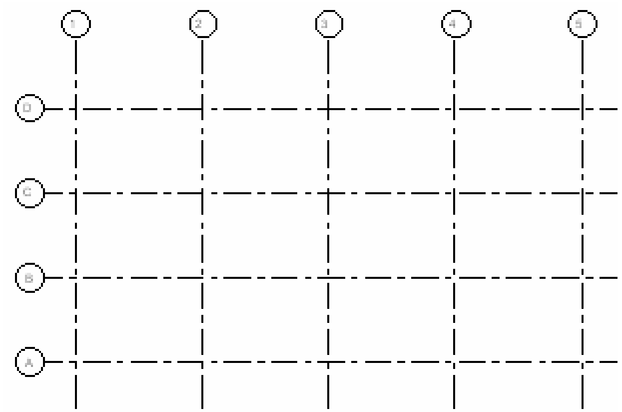


35. Right-click in the view, and choose **View Properties**.

36. In the **Element Properties** dialog box, click **Edit** next to **View Range**.

37. In the **View Depth** drop-down list, select **Associated Level**.

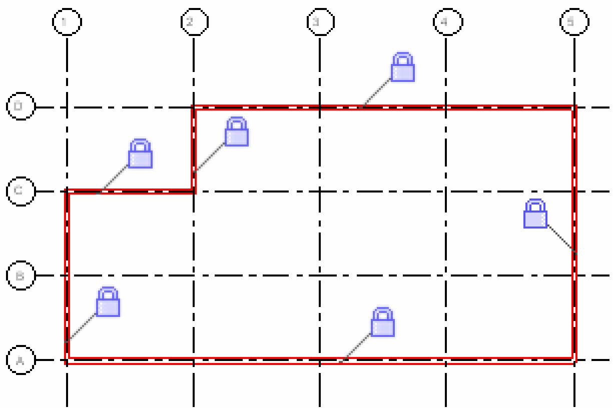
38. In the **View Range** and **View Properties** dialog boxes, click **OK**.



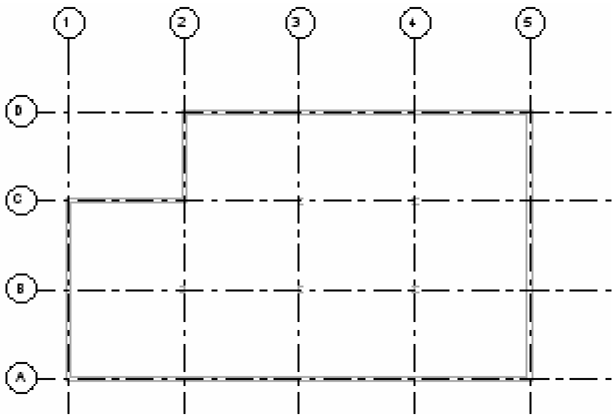
The foundation walls disappear because they are not in the view range.

39. On the **Basics** Design Bar, click **Wall**:
40. On the Options Bar:
    a. Set type: **Basic Wall: Generic- 200mm.**
    b. Set **Height** to **Level 2.**
    c. Check that alignment is set to **Wall Centerline**.
    d. Clear **Chain**.

41. Using the image as a guide, add these walls. All of them must be locked with the corresponding gridline. Lock each wall section immediately after drawing it.



42. Select the gridline 2. With the **Move** tool, move this gridline **300 mm** to the right.



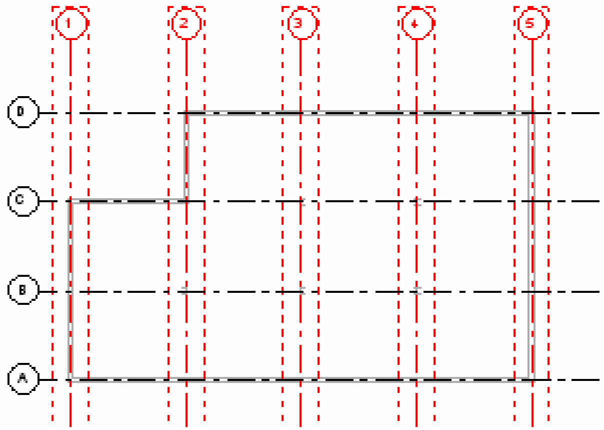
The distance between each vertical gridline is maintained. Each vertical bay is increased by 300mm because they are in a group created by the Array tool. This constrains their movement, so what you do to one bay is applied to all bays.

Because the walls are constrained to the grids, they move with the gridlines.

43. Select all the vertical gridlines, and on the Options Bar, click **Ungroup**.

44. Press **Esc.**

45. Repeat for the horizontal gridlines.

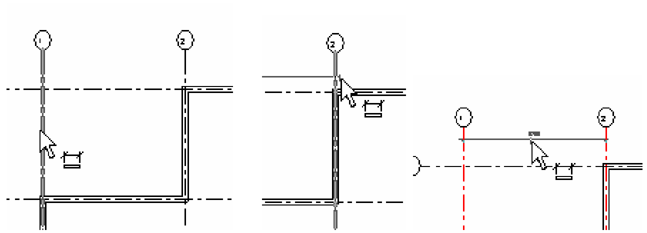


Each gridline can now be moved individually.

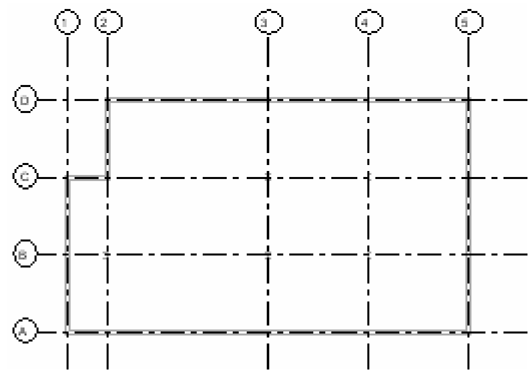
Now that you've ungrouped the element, the number of elements in the array can no longer be changed automatically.

The gridlines adjust as if you had used the Copy tool to create the five gridlines.

46. On the Basic Design Bar, click the **Dimension** tool.
47. Click **gridline 1** (on the line).
48. Click **gridline 2**.
49. Click in a white area of the screen above grid D to place the dimension.



50. Select **gridline 2** and change the dimension value to **2m**.



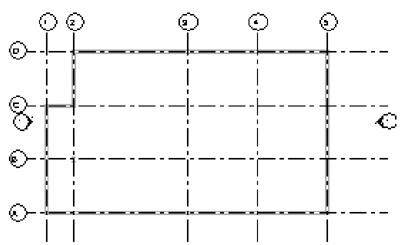
The grids are no longer constrained by the array, but the walls are still constrained to the gridlines.

Add Structural Columns to Gridlines

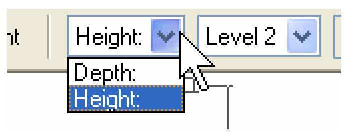
Like the foundation walls, structural members are often drawn down from the current level to the level below. This is a setting like walls on the Options Bar.

If you do not see the Structural tab on the Design Bar, you can add it by right-clicking anywhere on the Design Bar and choosing it from the context-sensitive menu.

51. Go to Floor Plans **Level 1.**



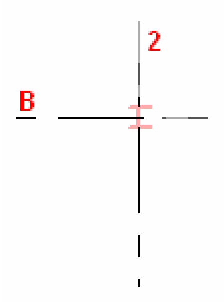
52. On the **Structural** Design Bar, click **Structural Column**.
53. On the Options Bar, set Level 2 as the height.



Structural components are automatically locked with gridlines.

Click exactly at the intersection: zoom in if

54. Click the intersection between gridline **B** and **2**.



necessary.

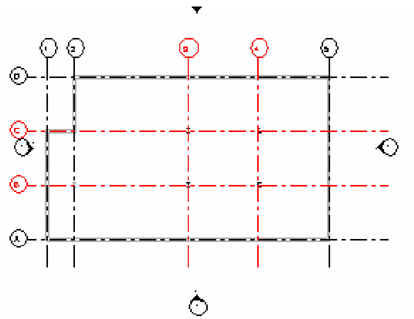
You have a choice as to the direction to draw the columns, up or down (height or depth).

Most of the structural elements, including the foundation, are drawn extending down. This includes the foundation wall and the structural columns.

55. On the Options Bar, click **Grid Intersection** and select gridlines **B**, **C**, **3**, **4**.

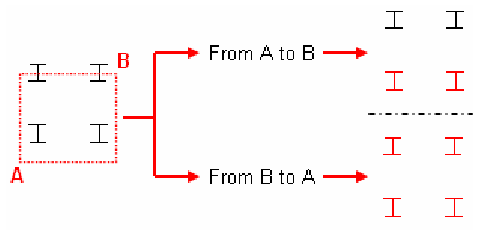
56. On the Options Bar, click **Finish**.

57. Press **Esc** twice.

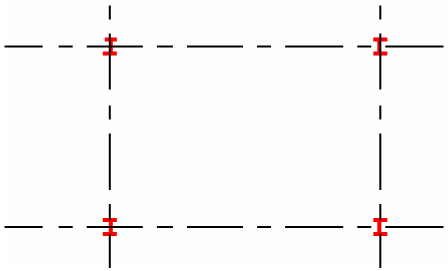


To enable multiselect, press the Ctrl key or select by frame.

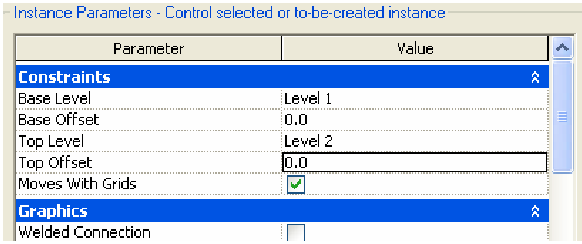
Click two points that define the frame. The direction used to create the frame determines selection mode.



58. Select the four interior columns.



59. With the columns selected, right-click Properties.
60. Verify:
    Base Level = Level 1
    Top Level = Level 2
    Top Offset = 0
61. Click OK.



Create an Extruded Roof

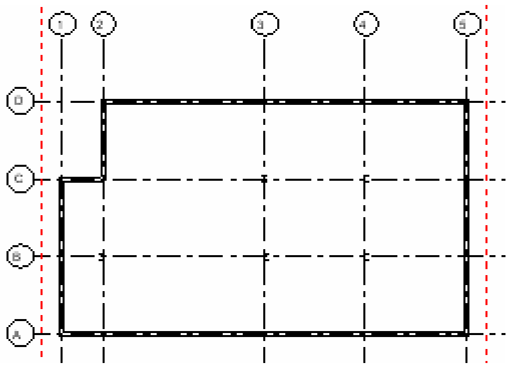
In this section you create two reference planes, as well as an extruded roof that is constrained to the reference planes.

Drawing a reference is like drawing a line; you simply click two points (start, end).

62. Go to Floor Plans **Level 1.**

63. On the **Basics** Design Bar, select **Reference Plane**.

64. Add a reference plane on the **west** and **east** sides of the building.



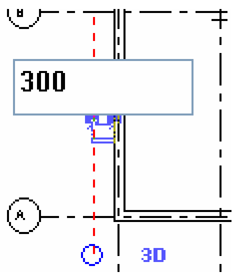
65. Press **Esc** twice.

66. Select the reference plane on the **west** side.

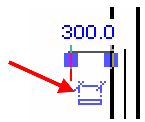
67. Change the value of the temporary dimension to **300mm**.

68. Convert the temporary dimension to a permanent one and lock it.

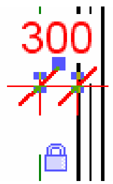
69. Perform the same operations for the **east** side.



To convert a temporary dimension into a permanent dimension, simply click the symbol below the dimension line.



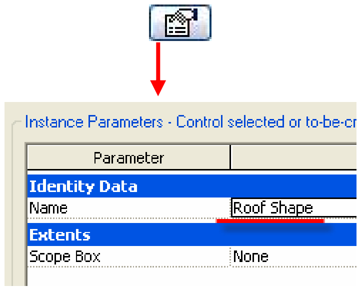
To lock the dimension, select it and click the blue lock symbol near the dimension line.

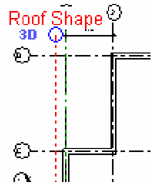


70. Select the **west** side reference plane, and on the Options Bar, click **Properties**.

71. In the **Element Properties** dialog box, type **Roof Shape** in the **Name** parameter.

72. Click **OK** in the **Element Properties** dialog box.



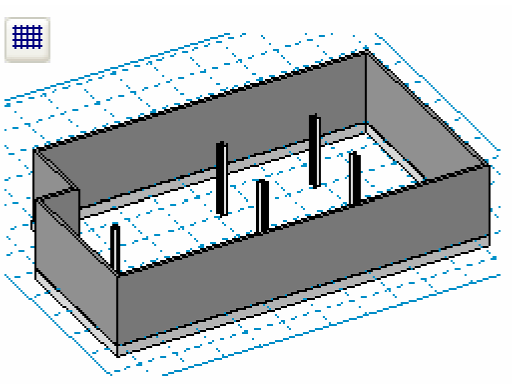


Once you name a reference plane, it displays that name when selected.

Add a Roof by Extrusion

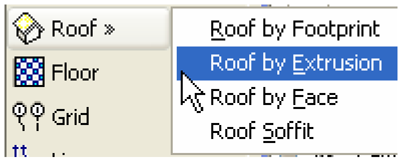
In this section, you use the reference plane as a work plane to draw an extruded roof.

73. Open 3D view, and click Work Plane Visibility on the Tools toolbar.



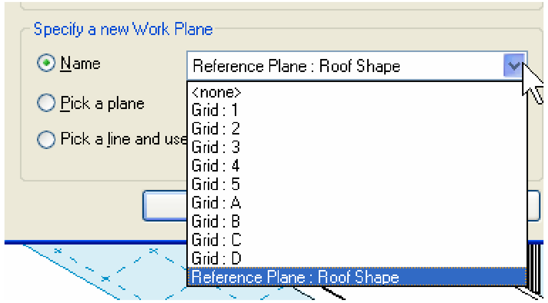
The blue grid is the work plane on which you are working when you create the sketch. In most cases Revit Building automatically creates a work plane that enables you to sketch. If Revit Building can't find a solution, it prompts you to select a suitable work plane.

74. On the **Basics** Design Bar, click **Roof**>**Roof by Extrusion**.

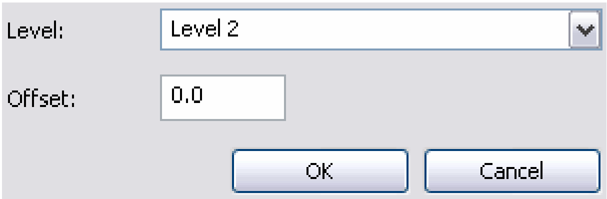


75. In the **Work Plane** dialog box, select **Roof Shape** in the **Name** drop-down list.

76. Click **OK** in the **Work Plane** dialog box.



77. In the **Roof Reference Level and Offset** dialog box, click **OK** to accept **Level 2** as a reference level for the roof.



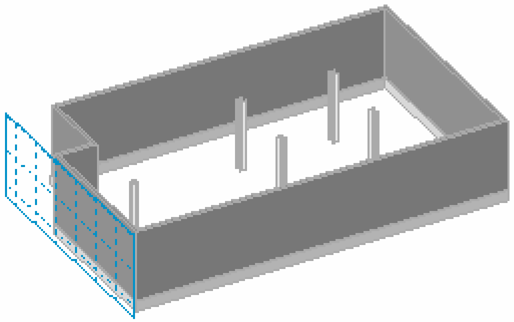
As you can see, if you name a reference plane, it automatically creates a work plane. This is a useful feature.

Work planes can be defined by a face on an object (a wall, for example), a reference plane, or a line.

Notice that each of the gridlines is automatically considered to be a work plane.

Work plane is aligned with the reference plane placed previously.

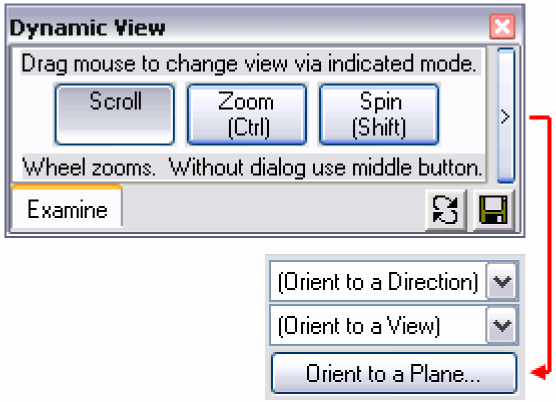
Click the Work Plane Visibility tool again if it has turned off.



To sketch the roof, it would be easier to have a point of view perpendicular to the work plane.

78. Press **F8** on your keyboard.

79. Expand the **Dynamic View** dialog box, and click **Orient to a Plane.**



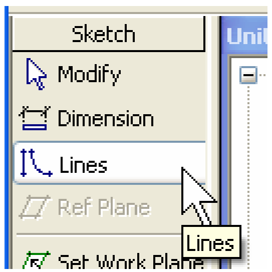
80. In the **Select Orientation Plane** dialog box select **Roof Shape** in the **Name** drop-down list.

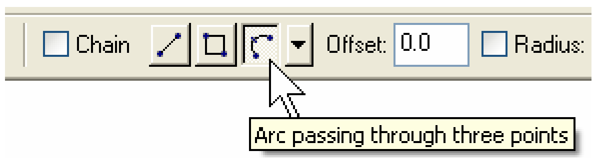
81. Click **OK** in the **Select Orientation Plane** dialog box.

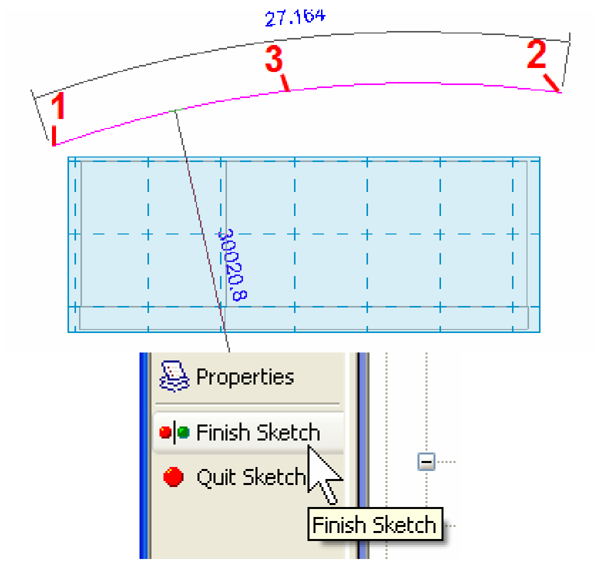
82. With the **Lines** tool selected on the Design Bar, click **Arc (Passing Through Three Points)** on the Options Bar.

83. Draw an arc with the image as a guideline.

84. On the Design Bar, click **Finish Sketch**.



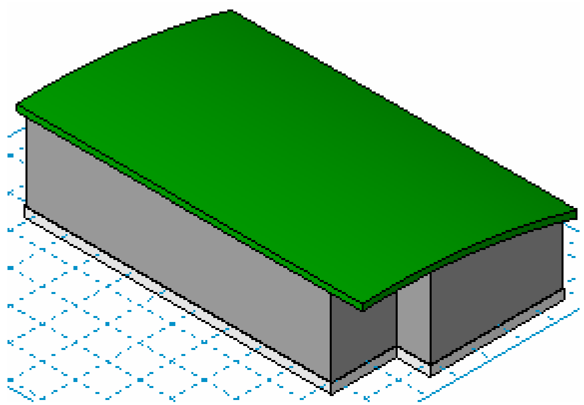




85. From the **View** menu, choose **Orient**>**Northwest**.

86. Highlight an exterior wall, press **Tab** on your keyboard, and click to select the walls.

87. On the Options Bar, click **Attach** and select the roof.

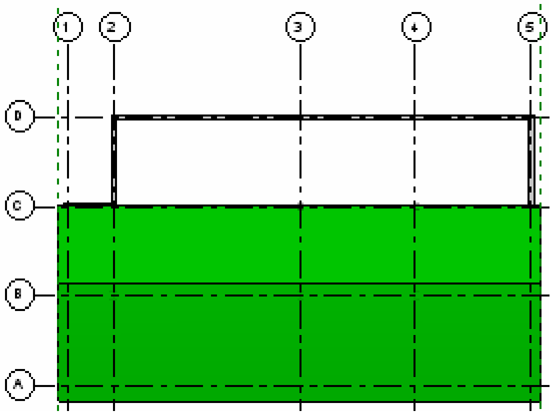


88. Go to Floor Plans Level 2.

89. On the **Tools** toolbar, click **Align**.

90. Click the **east** reference plane.

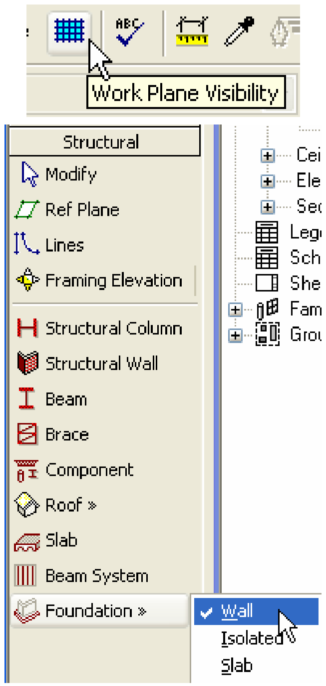
91. Click the edge of the roof.



Create a Strip Footing

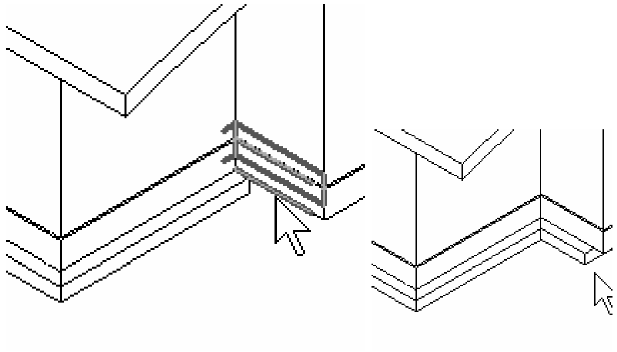
92. Open the 3D view.
93. Click the Work Plane Visibility tool to turn off the grid.

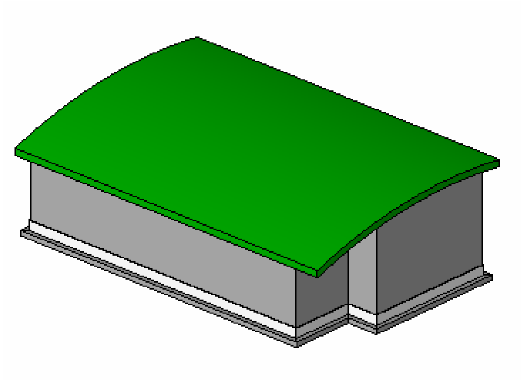
94. On the Structural Design Bar tab, click **Foundation>Wall**.



The Continuous Footing tool adds a spread footing at the base of a wall. In this case, you add the continuous footing at the bottom of the lower of the two walls.

95. Click the lower wall to add the continuous footing to the lower stem walls.





Now that your model is filled out, explore the constraints still on the walls and gridlines.

Unit 7

Theory: Design Information Organization

Autodesk Revit Building: Components, Groups, Categories, and Subcategories

This unit has two exercises. The first exercise provides a quick overview of the organizational structure of Autodesk Revit Building design objects. The second exercise explores the user-created organizational system of Revit Building groups.

Unit 7, Exercise A

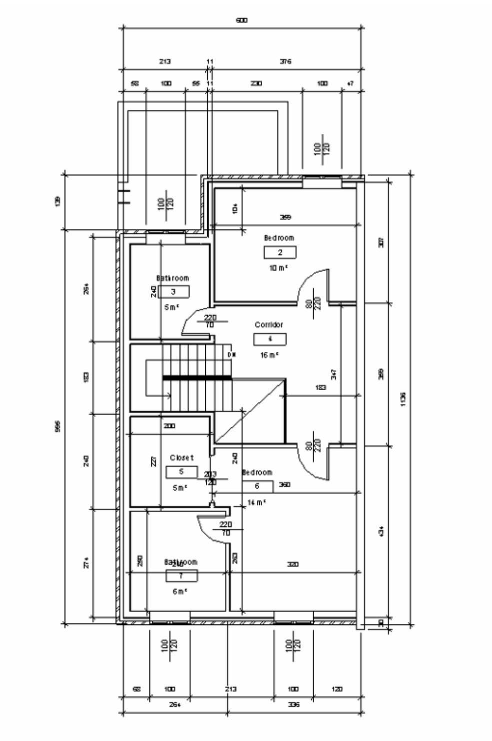
In this exercise you create and apply a view template to explore the categories and subcategories of object styles that are the basis for object organization and structure in Revit Building.

Create a New View and Apply a View Template

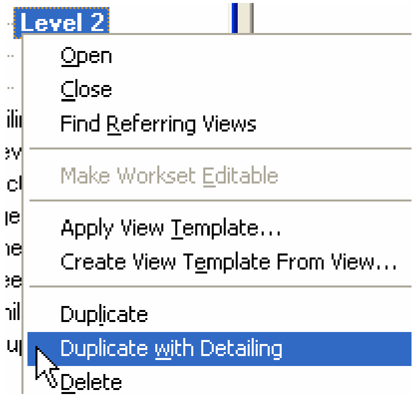
1. Open file **Unit 7a – start**.

2. The file should open with the **Floor Plan Level 2** active.

3. The plan view has a view template assigned to it (**Architectural Plan 1-50**).



4. In the Project Browser, right-click Floor Plans: Level 2 and choose **Duplicate with Detailing**.



Duplicate with Detailing copies the annotation elements that are placed in that view.

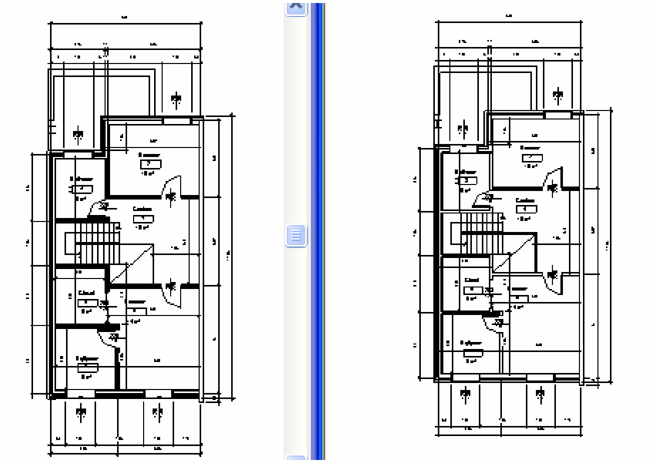
The new view has dimensions, tags, and other annotation copied from the original view.

Although you could use Duplicate rather than Duplicate with Detailing here, you are going to take care of these elements with a view template.

5. Right-click Floor Plans: Copy of Level 2, and choose **Rename**.

6. Rename this to **Level 2 Furniture**.

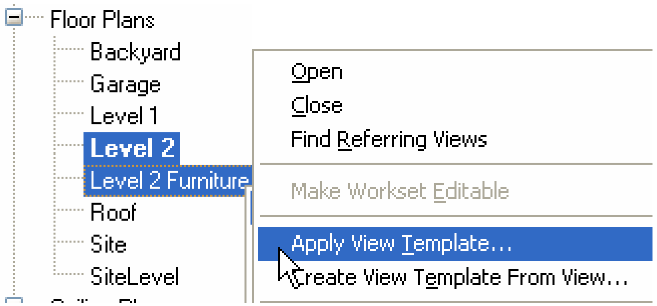
7. Tile the Level and Level 2 Furniture views.

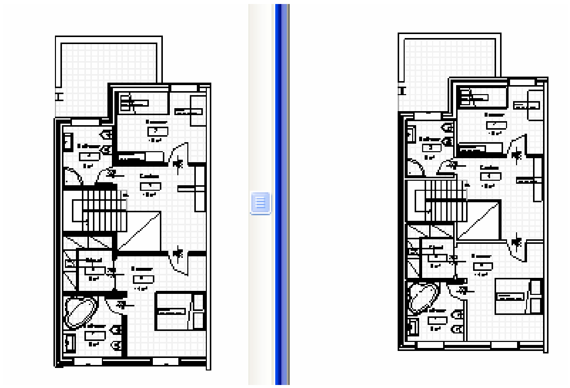


8. Hold the Control key and select both the Level 2 and Level 2 Furniture views.

9. Right-click and choose **Apply View Template**.

10. Click OK.





Both views have now been updated with the new set of visibility parameters stored in the view template.

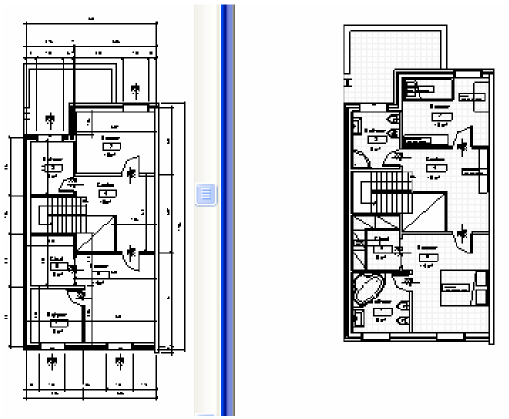
The Level 2 view is returned to its original state.

11. Right-click the Level 2 view in the project browser.

12. Choose **Apply View Template**.

13. Click the **Architectural Plan 1-50.**

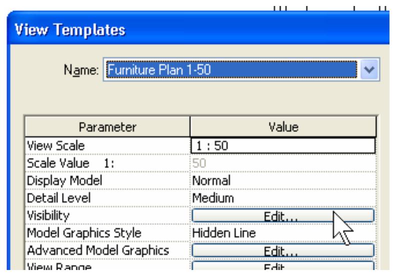
14. Click OK.



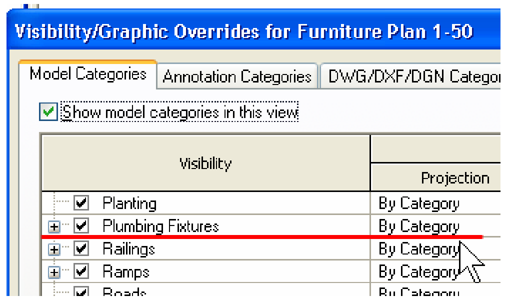
Edit the Furniture Plan View Template

In this section you edit the view template parameters to turn off the furniture and door tags.

15. From the Settings menu, choose **View Templates**.
16. Set the view template to edit to Funiture Plan 1 - 50.
17. Under Visibility, click **Edit**.

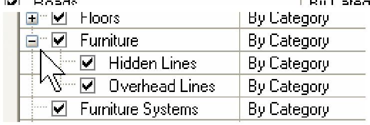


18. On the Model tab note that Plumbing Fixtures is set to By Category.



When a view uses the By Category setting, it is looking to the Settings>Object Styles for its display parameters. There are no overrides set for this view template.

19. Expand the Furniture category.

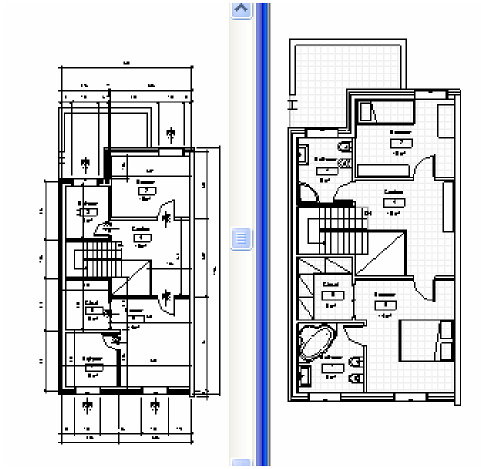


These are the subcategories of Furniture. In general, subcategories are established by the families as you load them into the project. You create a new subcategory later in the exercise.

20. Click the Annotation tab.
    - Clear Door tags.
    - Clear Furniture tags.
    - Verify that Dimensions, Elevations, and Sections are cleared.
21. Click OK two times to return to the drawing window.
22. Set the Level 2 Furniture view current.
23. From the **View** menu, choose **Apply View Template** and select **Furniture Plan 1-50**. Note how some components disappear while others appear.

Clearing these elements tells Revit Building not to display them when you apply this view template.

The door tags and furniture tags have been turned off for this view only.



You can save visibility settings in View Templates and recall them to be assigned at any point to any view. The visibility settings define what categories and subcategories are visible within a view.

To save the active visibility setting that you define as a view template, go to menu View>Save as View Template.

To apply a view template, go to menu View>Apply View Template.

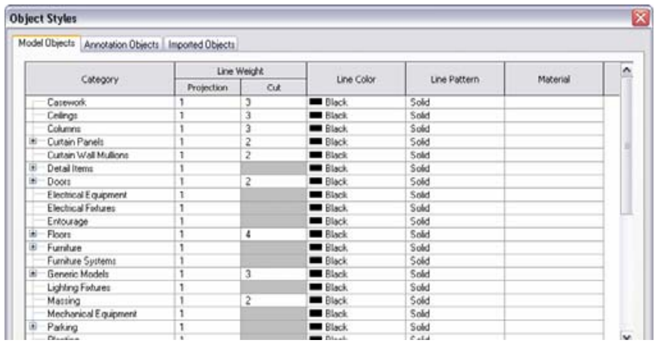
To change View Template settings, go to menu Settings>View Templates.

Change an Object Style Globally

The object styles control the linework representation for all the objects. Changes you make in this dialog box affect all views that do not have an override in place.

Use Category/Subcategory structure to manipluate the settings for the lineweight, line pattern, and material for the objects.

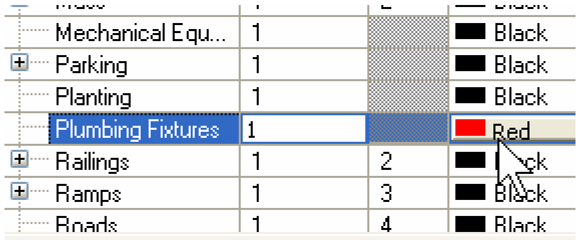
24. From the **Settings** menu, choose **Object Styles.**



The Object Styles dialog box has three tabs: Model Objects, Annotation Objects, and Imported Objects.

You can control the appearance of model and annotation objects from the first two, while on the third tab you can control display settings for imported objects such as DWG format files (line color, weight, style).

25. Scroll down the window to **Plumbing Fixtures** and change color to **Red**. Click OK.

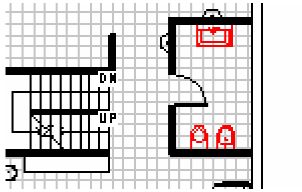


Because styles are not view specific, changing the color of a category affects the display of that category in all views.

26. Open the **Level 1 plan view**.

27. Verify that the plumbing fixtures have assumed the new color settings.

28. Close the Level 1 Plan view.

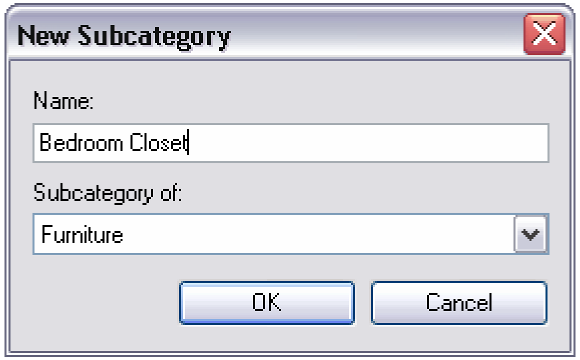


Create and Assign a Subcategory

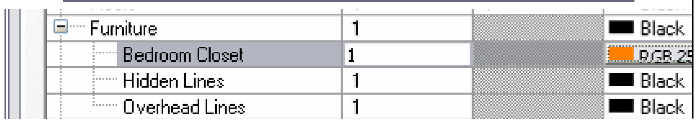
Subcategories are primarily used by families as a means of providing visibility, lineweight, and material assignment control of the subcomponent of the family.

29. Scroll and expand the **Furniture** category.

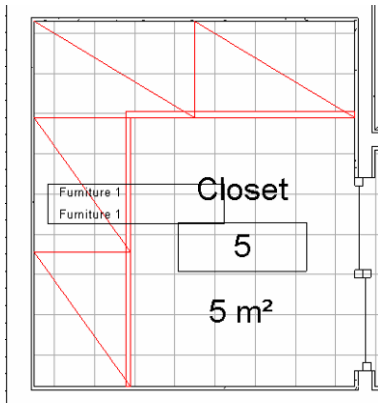
30. Click the **New** button, to add a subcategory called **Bedroom Closet**.



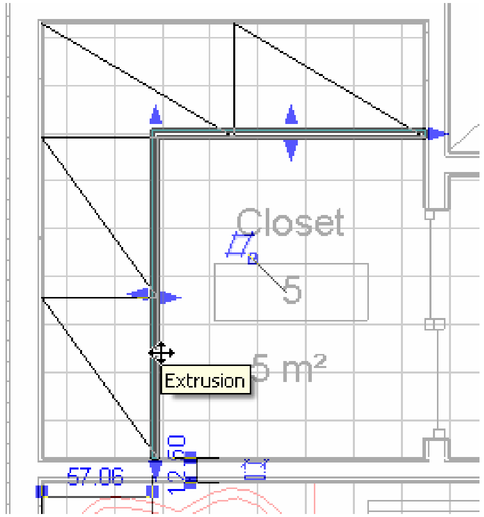
31. Click **OK**, and change the **subcategory color** to **Orange** by clicking the color column.



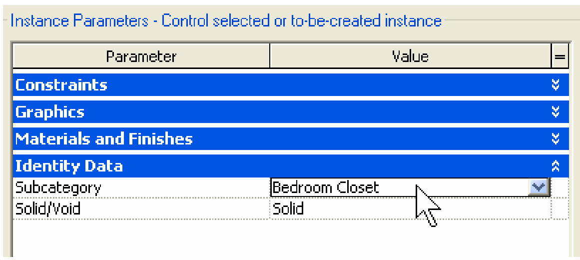
32. Select the furniture item inside the closet in the main bedroom (see image). It's an in-place family. On the Options Bar, click **Edit**.



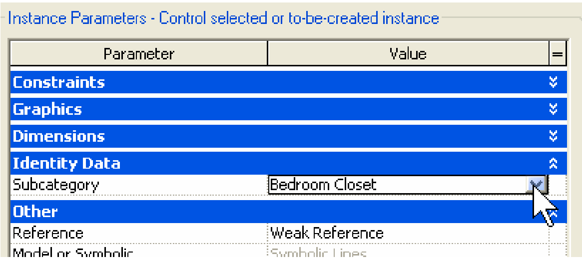
33. Select the shelves of the closet (see image), **right-click**, and choose **Properties**.



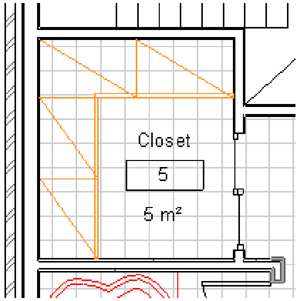
34. Change the subcategory to **Bedroom Closet.**



35. Select the symbolic lines defining the closet, **right-click,** and choose **Properties**. Assign the subcategory **Bedroom Closet**.



36. Click **OK** to close window, and on the Design Bar, click **Finish Family**. Note the color change of the components.



37. The visibility of the Bedroom Closet subcategory can be switched off even if the rest of the furniture is visible. Open the **Visibility settings** for this view and expand the **Furniture** category. The Bedroom Closet subcategory is now available.

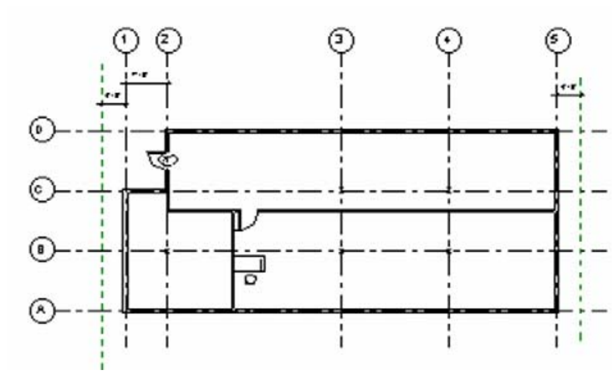
You can override the color of the category or subcategory by opening the visibility settings for the view and setting a view override.

Unit 7, Exercise B

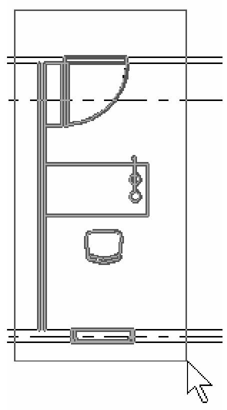
The second exercise explores the user-created organizational system of groups.

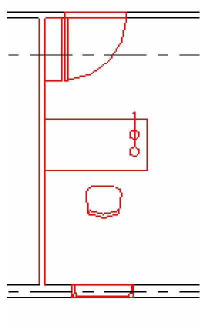
Create a Group

1. Open the data set **Unit 7b – start.rvt**.

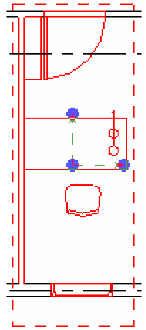


2. Verify that the Floor Plans Level 1 is current.
3. Zoom into the desk and chair.
4. Select the wall, shelf, door, window desk, and chair.



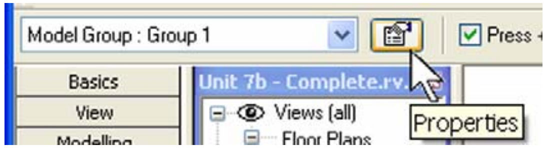


5. Click Group on the toolbar.



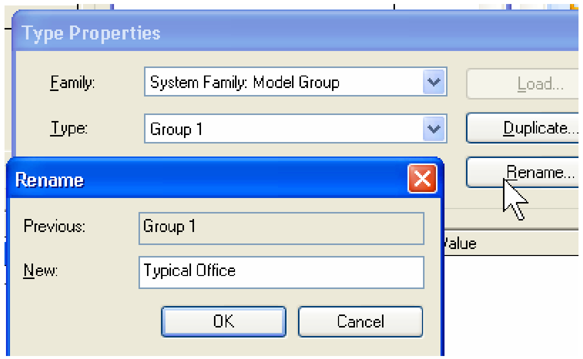
The group is created, but is named Group 1.
It is a good habit to name your groups as you create them.

6. While the group is still selected, on the Options Bar, click **Properties**.



7. In the Properties dialog box, click **Edit/New**.

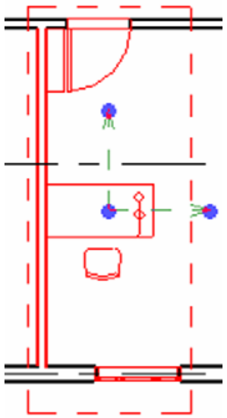
8. In the Type Properties dialog box, click **Rename**.
9. Name the new group **Typical Office**.

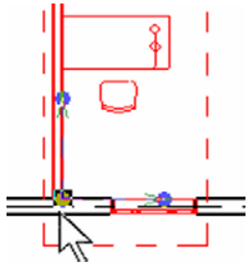


10. Click OK until you are back in the drawing window.

The group has three grips. The middle grip is the insertion point of the group.

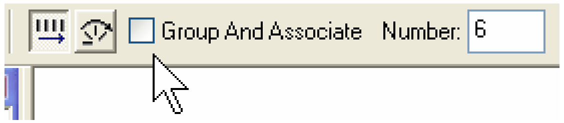
11. Drag the insertion grip to the lower-left corner of the space.



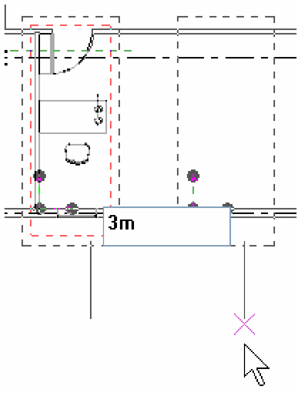


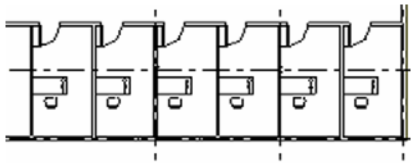
Array the Office Group

12. With the group still selected, click the **Array** tool, and on the Options Bar set:
    a. Array type = linear
    b. Clear Group and Associate
    c. Number = 6
    d. Move to 2nd
    e. Constrain = selected



13. Click anywhere in the drawing window for the first point of the array.
14. Drag to the right.
15. Type **3m** and press the **Enter** key.



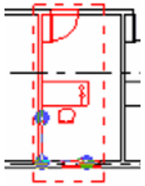


The array is created. You cleared Group and Associate because the office parts are already in a group.

Modify Groups

You can modify, add, or subtract from the objects in the group.

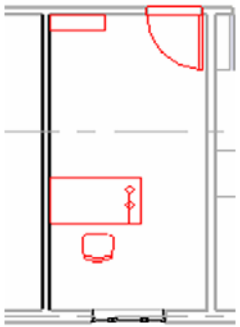
16. Click any of the groups.



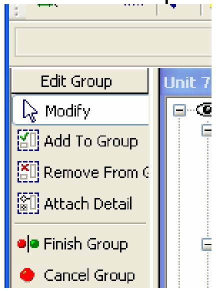
17. On the Options Bar, click the **Edit Group** tool.

The group is open for editing. Those objects not in the group are dimmed and not accessible.

18. Redesign the office:
    - Move the desk, chair, and lamp toward the window.
    - Move the door against the right wall.
    - Rotate the shelf.

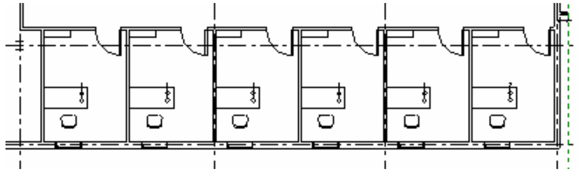


When you are editing the group, you can move the group components around, but you cannot add new components directly.



The Design Bar lets you operate only on the objects already in the group.

19. On the Design Bar, click the **Finish Group** tool.

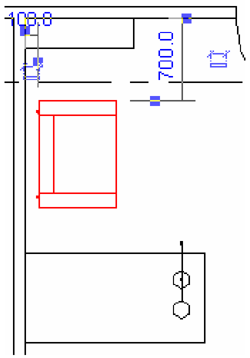


The change is propagated through each of the offices. Even objects such as doors and windows that have relationships to the other elements can belong to and be modified by groups.

Add Components to a Group

To add components to a group, they must first exist in the project.

20. Use the Component tool to add an M_ Chair-Corbu to the left office.

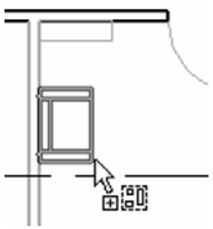


21. Click any of the groups.

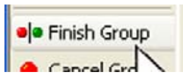
22. On the Options Bar, click Edit Group.

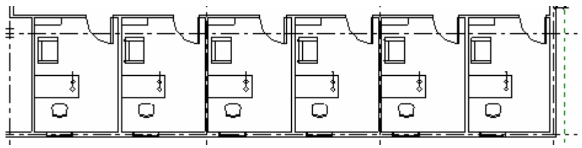
23. Click the Add to Group tool.

24. Click the chair you added.



25. On the Design Bar, click the Finish Group tool.





The chair is added to each of the offices.

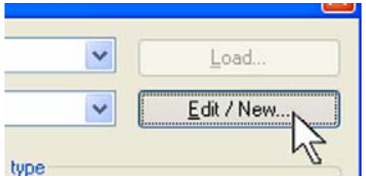
Once a group is defined in the project, it acts much like any other Revit Building object. You can create types based on the original.

Duplicate the Group

26. Click the left office group.

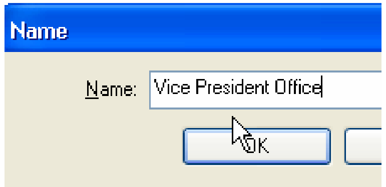
27. On the Options Bar, click **Properties**.

28. Click the **Edit/New** button.

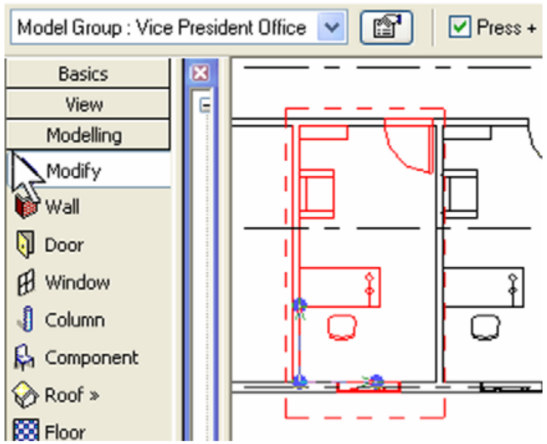


29. Click the **Duplicate** button.

30. Name the new group **Vice President Office**.



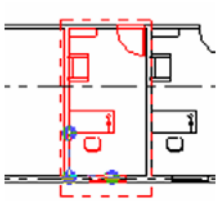
31. Click OK to return to the drawing window.



The group selected when you accessed the properties takes on the new group definition.

Modify the New Group

32. Select the **Vice President Office** groups.



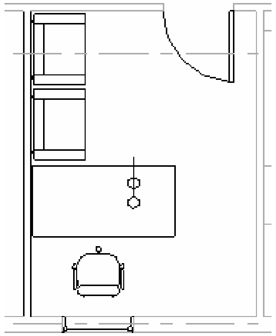
33. On the Options Bar, click the **Edit Group** tool.

34. Copy the **M_Chair – Corbu** and remove the shelf to make room for it.

35. Change the desk type to **M_Desk 1830 x 915mm**. Move it into place.

36. Change the chair type to **Executive**.

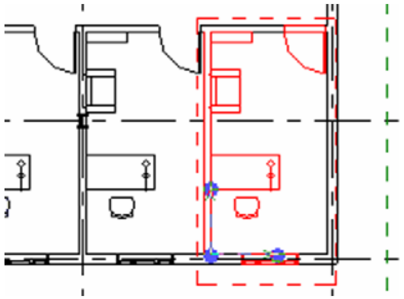
37. On the Design Bar, click the **Finish Group** tool.



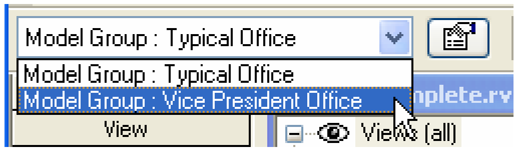
Changes to the Vice President Office group do not affect the other groups in the project because they are of a different type.

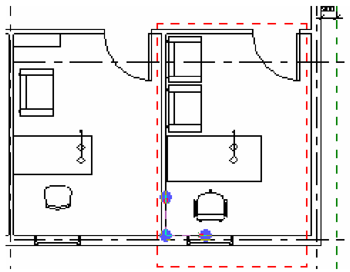
Apply Group Type to Another Group

38. Click the group on the far right.

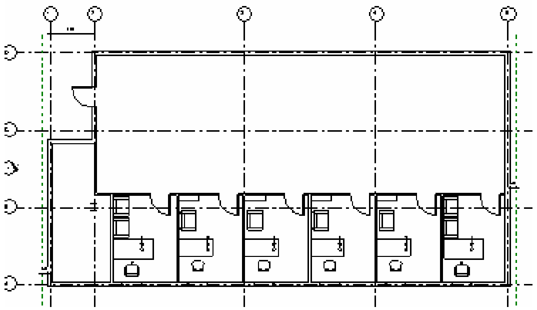


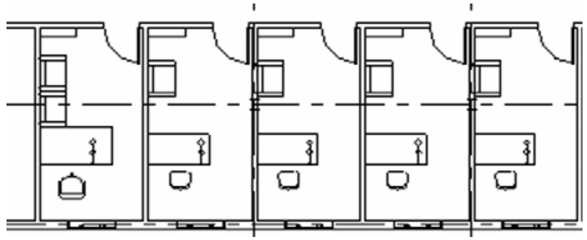
39. Change the group type on the Options Bar to **Vice President Office**.





40. Save and close the project.





Groups can be powerful tools for working with sets of objects within the Revit Building environment.

On your own, further explore the use of groups. Create an entry for the building. Can you create groups that you can swap out for one another, showing different solutions to the entry design?

You can insert groups using the Design Bar>Modeling tab>Model Group tool.
You can export groups and load groups using the File menu: Save to Library and Load from Library. These files are stored as RVG files outside the project (RVT) environment.

Unit 8

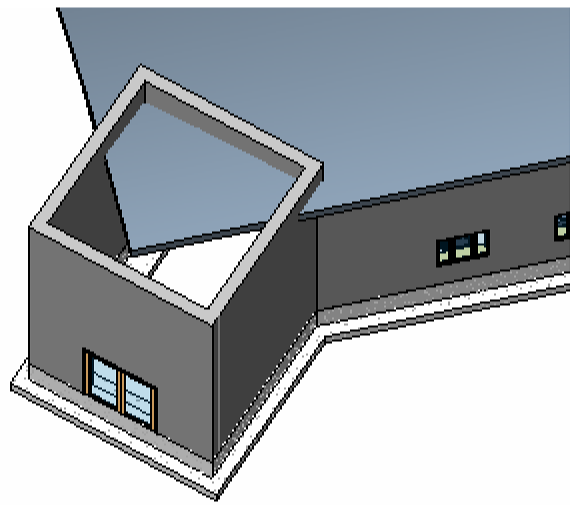
Theory: Domain-Specific Knowledge

Autodesk Revit Building: Roofs

This exercise takes you through adding some more detail to the roof in addition to taking a look at how to put together multiple roofs to achieve different forms.

Exercise Setup

1. Open the data set **Unit 8 - start.rvt**.

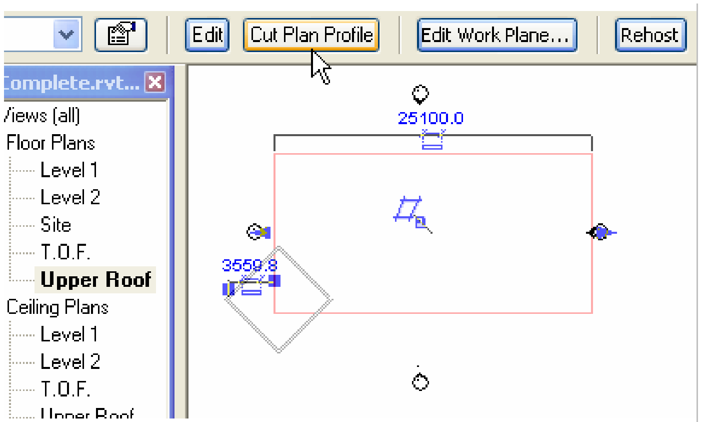


This data set is the same as the building at the end of exercise 7b. The southwest corner has been added and a new level called Upper Roof has been created.

2. Clip the Extruded Roof.

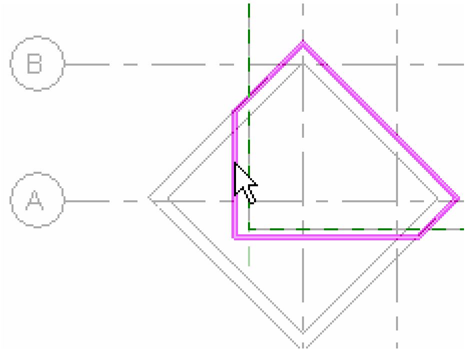
Any extruded roof (as opposed to a roof by footprint) can be cut using the Cut Plan Profile tool.

3. Set the **Upper Roof Plan** view current.
4. Click the roof in the plan.
5. On the Options Bar, click the **Cut Plan Profile** tool.



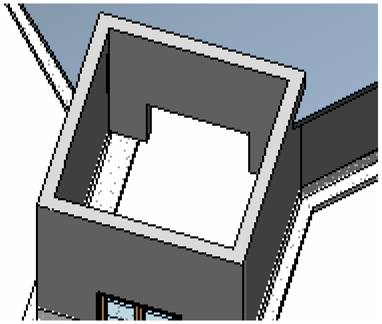
This process initiates sketch mode. Just draw the shape you want to remove from the extruded roof. This must be a closed shape.

6. Draw a shape that follows the outer edge of the upper walls.



Notice the linework on the south and west sides is outside the roof. Try not to make the lines coincident with the edge of the roof.

7. On the Design Bar, click the **Finish Sketch** button.



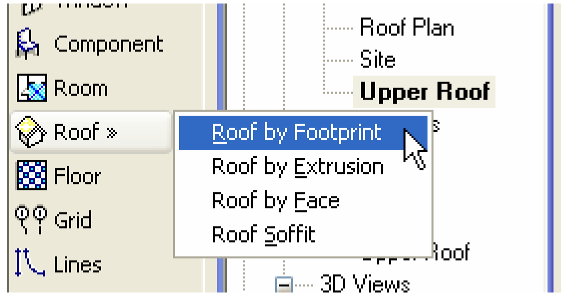
The shape that was sketched is now removed from the extruded roof.

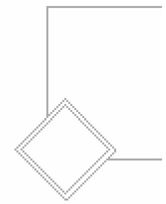
Roof by Footprint: Pick Walls Versus Lines with Offsets

Here you create an upper roof on the entry walls. An earlier unit illustrates Roof by Footprint, and here we discuss some of the limitations and workarounds using the roof you create in this section as a basis for a slightly more complex (to Revit Builidng) roof.

8. Set the **Upper Roof** view current

9. Click the **Roof>Roof by Footprint** tool.



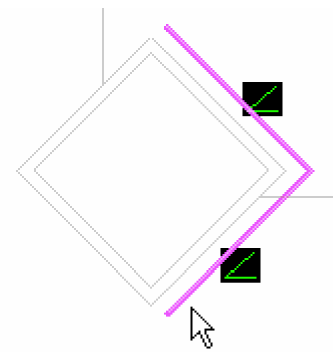


10. On the Sketch Design Bar, click **Pick Walls**.

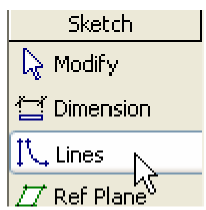
11. On the Options Bar, set:

    a. Defines Slope = selected
    b. Overhang = 600
    c. Extend to Wall Core = selected

12. Click the two east walls to create the lines as shown at right.



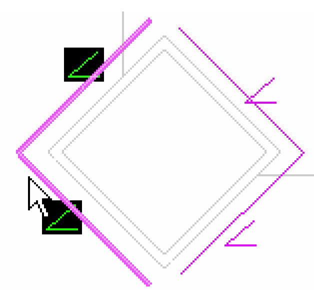
13. On the Sketch Design Bar, click **Lines**.



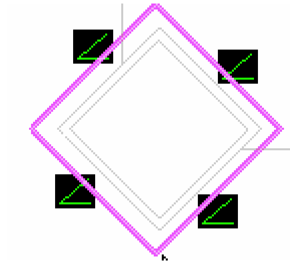
14. On the Options Bar, set:

    a. Draw method = Pick Lines
    b. Defines Slope = selected
    c. Offset = 600

15. Draw the two lines on the west side shown in the image.

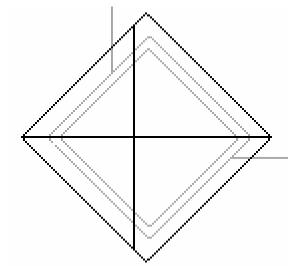


16. Use the Trim tool to clean up the corners of the linework.



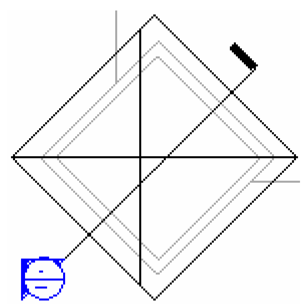
17. On the Sketch Design Bar, click **Roof Properties**.
18. Set the slope angle = 30.000°.
19. Click OK to return to the drawing window.

20. On the Sketch Design Bar, click **Finish Roof**.

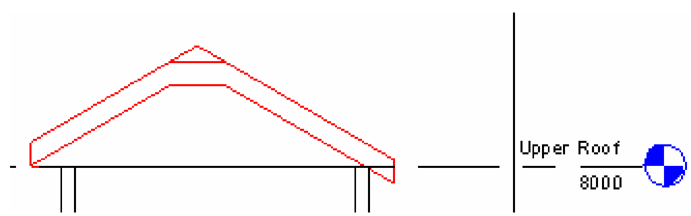


The roof is created, but not symmetrical to the entry walls. This is because of the differences in the lines created by picking walls versus using the Lines tool.

21. Add a section as shown here.

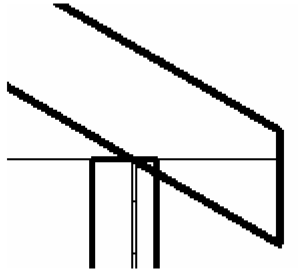


22. Open the Section view and tile the two views; Section 1 and Upper Roof.



The sketch lines drawn with the Lines tool originate at the edge of the roof at the level the roof is constrained to (left side of image).

The sketch lines drawn with the Pick Walls tool establish the facia edge of the roof below the level by a distance determined by the slope of the roof over the overhang setting.



Notice also that the Pick Walls tool had Extend to Core selected. The outside face of the core (the metal studs) of the wall is used and the overhang of 600 is calculated from this point rather than the exterior face of the entire wall. As such, the overhang on the “Picked Walls” is slightly less than the overhang of the drawn line segments

Align Eaves

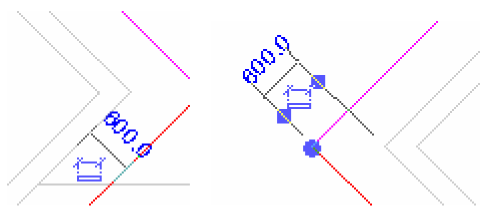
Align Eaves is a tool in the sketch mode of a footprint type roof.

23. Set the **Upper Roof** view current.

24. Click the roof.

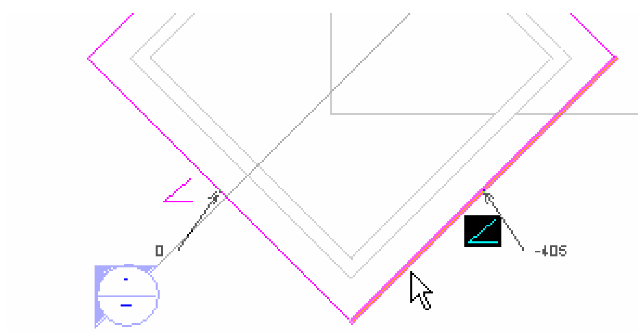
25. On the Options Bar, click the Edit button.

26. Click each of the lines and use the temporary dimensions to adjust the distance to the face of the wall to 600.

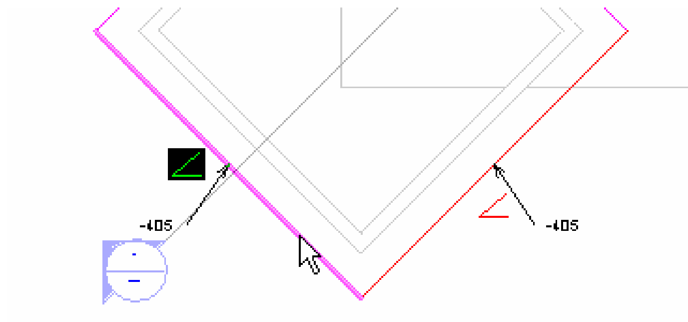


27. On the Sketch Design Bar, click the **Align Eaves** tool.

28. Click the eave to align to (the southeast line).



29. Click the eave to align (the southwest line).



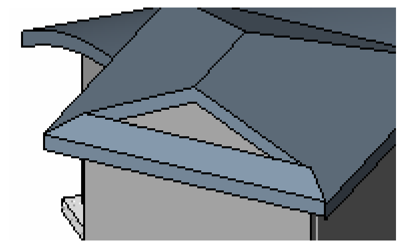
30. Repeat for the northern lines. All the sketch lines should now be set to the same value.

31. On the Sketch Design Bar, click **Finish Roof**.

The roof should now be symmetrical to the underlying entry walls.

Create Multiple Roofs

Sometimes you need to create two or more roofs to complete the shape you are looking for. Any roof with a discontinuity in the form probably needs to be created from two different roof objects. This section guides you though creating a simple example of such a roof, as shown at the right.



32. Open the roof sketch for editing.
    a. Set the **Upper Roof** view current.
    b. Click the roof.
    c. On the Options Bar, click the **Edit** button.

33. On the Sketch Design Bar, click **Roof Properties**.

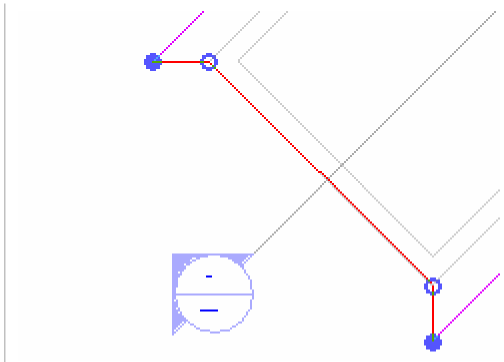
34. Click OK to return to the drawing window.

35. Delete the southwest line.

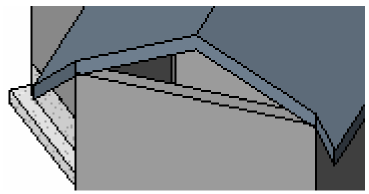
36. On the Sketch Design Bar, click **Lines**, and on the Options Bar set:

    a. Draw method = Draw
    b. Defines slope = Cleared
    c. Offset = 0

37. Draw the three lines on the west side shown in the image. Verify that these lines do *not* define slope.

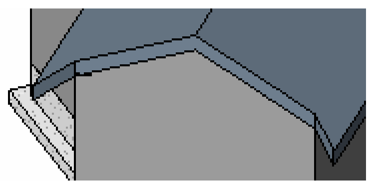


38. On the Sketch Design Bar, click **Finish Roof**.



39. If you want, you can extend the wall to the roof:

    a. Open a 3D view.
    b. Click the southwest wall.
    c. On the Options Bar, click Top/Base **Attach**.
    d. Click the roof to attach to.

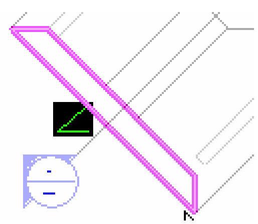


Add the second roof to complete the form.

40. Set the Upper Roof view current.

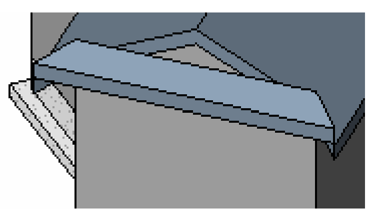
41. Click the **Roof>Roof by Footprint** tool.

42. Use the Lines tool to draw the lines shown at the right.



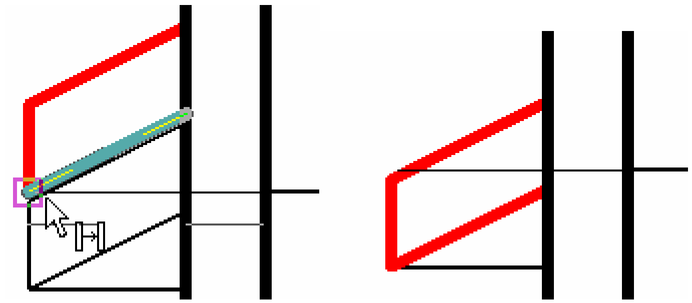
Note only the outermost line defines a slope. The other three do not.

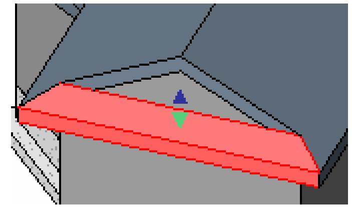
43. On the Sketch Design Bar, click **Finish Roof**.



The roof is finished, but like the first roof in the exercise the linework is based at the upper roof level rather than the eave of the existing roof.

44. Open the section view and use the Move tool and snaps to move the roof into place using the roof beyond as the reference.



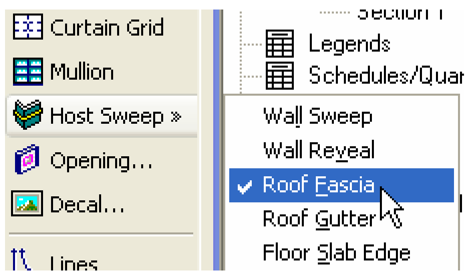


Create Fascias and Gutters

Revit Building provides the ability to sweep a shape around the edge of a roof. This can be any shape stored in a roof sweep type of profile family. The odd thing about many of the sweeps is that although the shape definition is stored in a family (RFA file) the definition is buried (or nested) in a system family definition in the project file.

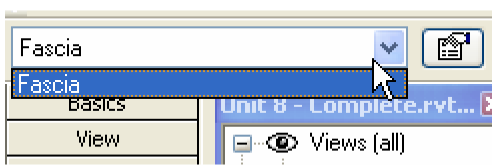
45. Open the 3D view of the project.

46. Click the Modeling tab of the Design Bar, and then click the **Host Sweep>Roof Fascia** tool.

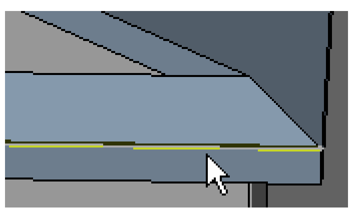


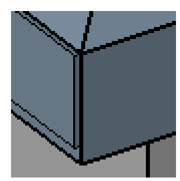
Note the fascia is a system family (defined only in the project, not as an RFA file). There are other families you can load and use in the project but you would need to duplicate this type and assign the loaded profile into the type parameters of the new type.

47. There is only one type defined in this project.



48. Click the upper edge of the fascia area of a roof.

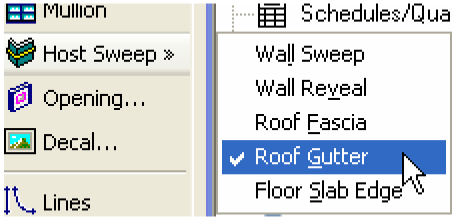




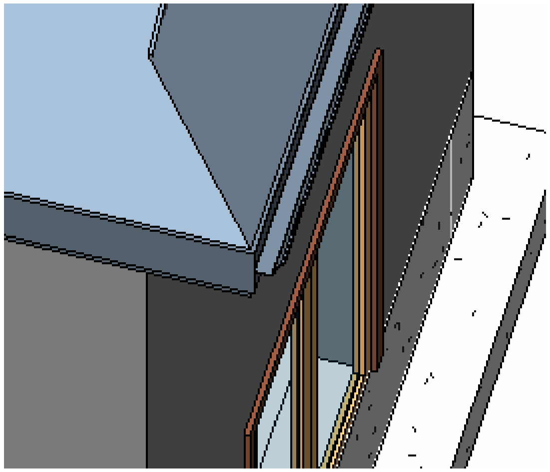
49. Continue clicking edges to add the fascia to

each edge of the roof.

50. Click the Modeling tab of the Design Bar, and then click the **Host Sweep>Roof Gutter**.



51. Click the fascia edge about the entry door.



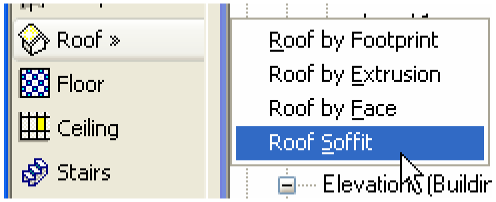
Be careful as you select. Because the inside face of the fascia, the roof and the outside face of the fascia are all very close together, it is easy to add the gutter to wrong edge.

Create Soffits

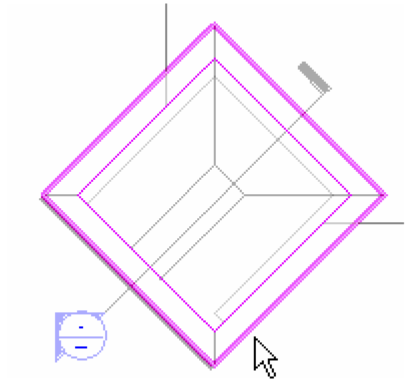
Creating a soffit in Revit Building is much like creating a roof.

52. Set the Upper Roof level current.

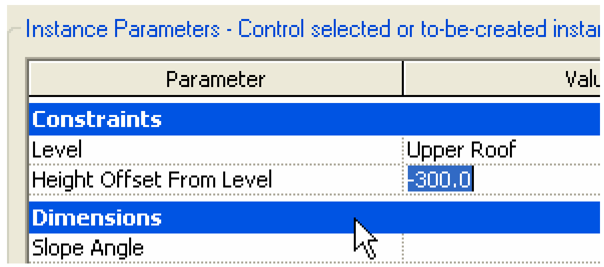
53. Click **Roof>Roof Soffit**.



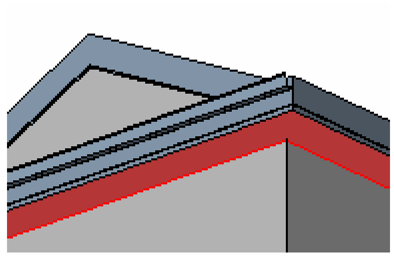
54. Draw two sets of lines as shown in the illustration.



55. On the Sketch Design Bar, click the **Roof Soffit Properties** and set the Height Offset From Level to -300.0.

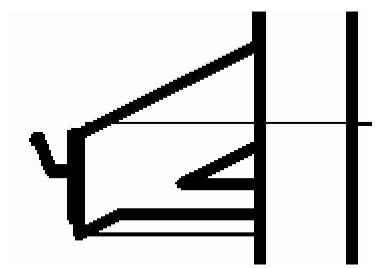


56. On the Sketch Design Bar, click **Finish Sketch**.

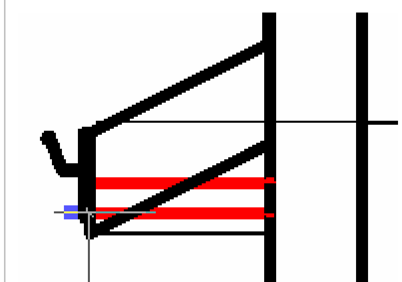


57. Click the **Join Geometry** tool.

58. Click the soffit, and then click the roof.



Although there are automatic selection tools that allow you to select roofs and walls, because this is not just a single roof, you may find it easier to draw the lines manually.



The two geometries are joined and the profile line wraps both objects.

Unit 9

Theory: Delaying Specificity

Autodesk Revit Building: Massing

There are two exercises in this unit. This first exercise guides you through the process of adding mass elements to a Revit Building project. The second illustrates the software's ability to import SketchUp files and how to use them as mass elements.

Unit 9, Exercise A: Mass Components and Building Maker

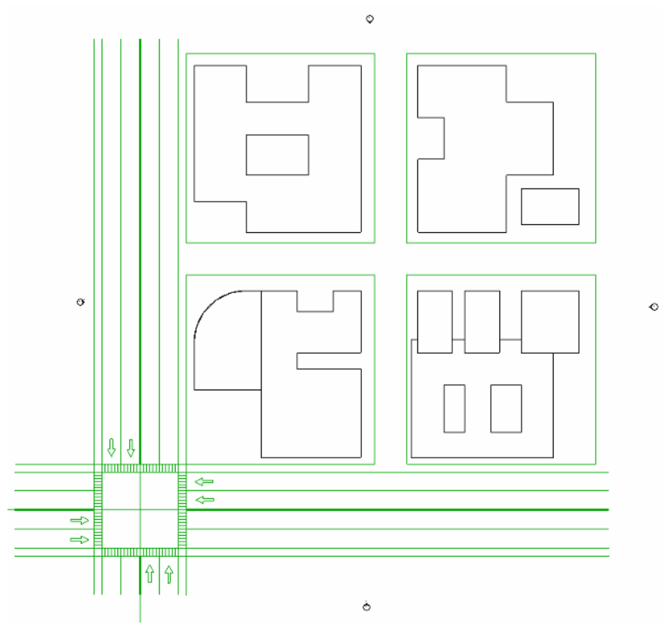
In this exercise you work with Autodesk Revit Building software's **Building Maker**. Building Maker is a collection of tools that includes

- Mass elements composed of solid forms and void forms
- Walls, floors, roofs, and curtain systems associated with the mass faces

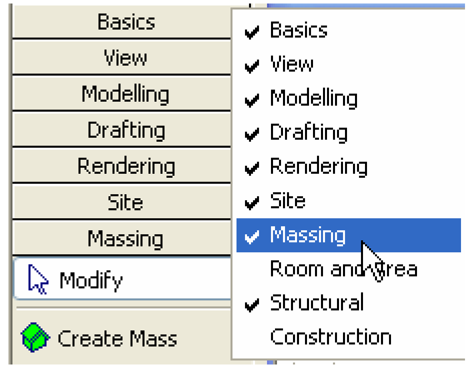
The general workflow in this exercise is to create the mass forms, apply the building elements to the faces, modify the forms, and then update the building elements to the new geometry of the changed form.

Create a Mass Element

1. Open file: **Unit 9a – Start.rvt**.



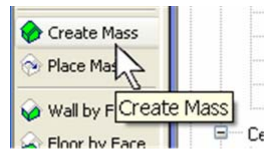
2. In **site view**, right-click the Design Bar and choose **Massing** from the context-sensitive menu to show the **Massing Design Bar** if it is not already visible.



Design Bars can be displayed or hidden to optimize screen space.

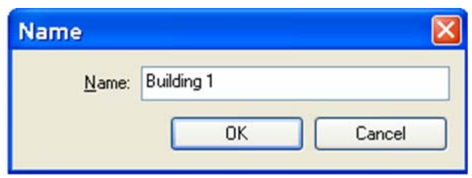
Add a Mass

3. On the Massing Design Bar, click **Create Mass.**

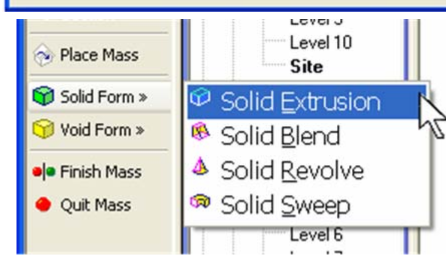


Both Additive (Add Mass) and Subtractive (Cut Mass) Masses are created in sketch mode.

4. Click OK in the Show Massing dialog box if it appears.
5. Give the massing a name.



6. The Massing dialog box appears. Click **Solid Form>Solid Extrusion**.

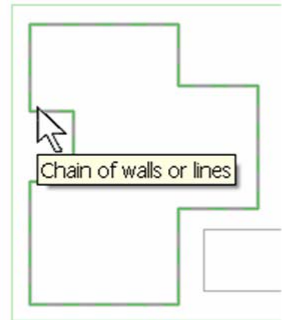


Forms can be created in four standard ways, (extrusion, blend, revolve, sweep) and can be either solid or void. Voids are subtractive forms that cut geometry from solid forms.

7. On the Options Bar:
   a. Enter **25m.**
   b. Click the **pick** lines (the pencil symbol).
8. Zoom in the upper-right city block and highlight one of the lines that defines the building footprint.

Sketch lines can be drawn or selected. When selecting, it's possible to automatically lock the lines to the original drawing by clicking the Lock option on the Options Bar.

9. Press Tab to chain-select all the lines.

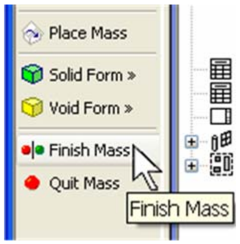


Like selecting a chain of walls, you can click connected lines to generate sketch lines by using the Tab key.

10. Click **Finish Sketch** to complete the mass.

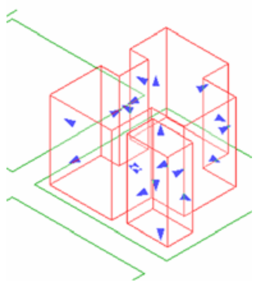
Quit Sketch discards the lines that were drawn in sketch mode.

11. Repeat steps 6–10 to create a mass for the small building on the same block.
12. Click **Finish Mass** to complete the mass.



This is a nested series of sketch modes. One mode takes you to the mass creation set of Design Bar options. When you start a solid or void, you drop down one more level and the Design Bar changes to a more familiar sketch mode. You must click Finish Sketch and Finish Mass to complete the command.

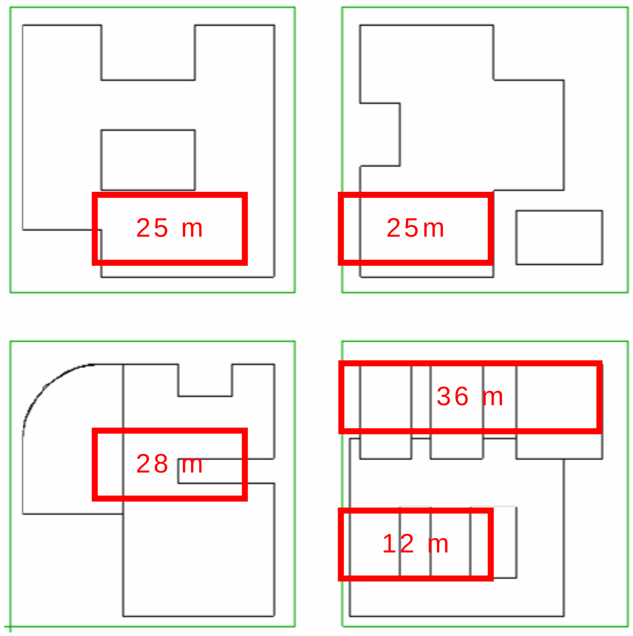
13. Change to the 3D view.



You have drawn two shapes in the mass element sketch mode. These will be two parts on a singular mass element when selected.

14. Return to the **site** view and repeat the process with all the building footprints in the blocks.

15. Set the mass heights as shown in the image on the right. Note: Because some masses have two loops of lines, as in the building in the upper left, use Tab to select both of the closed-line loops.
    Name the Building in the southwest corner Building 3. You work with this building later in the exercise.

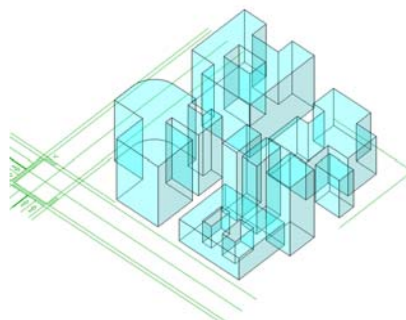


Change heights (or depths) after creating the masses by selecting the mass, opening its Properties dialog box, and changing the value in the Beginning and End fields.

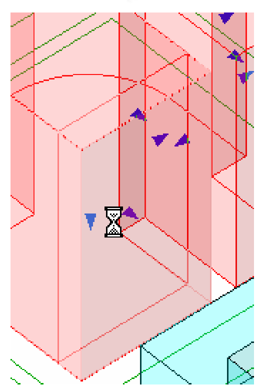
Note that for some of the buildings, you may have to complete the sketch by drawing lines instead of just selecting them.

Create the building at the lower right as two different solids within one mass element. Don't try to make it two parts of the same solid extrusion.

16. Open the **3D view**. Type **SD** for a shaded view of the massing.



17. Select the southwest mass and resize it by dragging the blue grips that appear (there is one grip for each face).

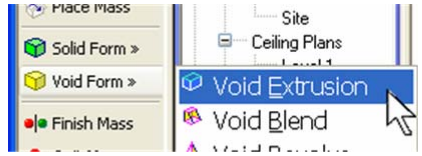


Edit masses directly in any view by dragging the grips.

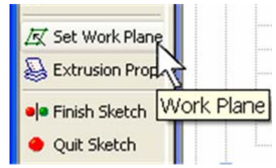
Edit the Southwest Mass to Add a Void

The process of adding a void—or subtractive solid—is the same as creating the original solid.

18. With the southwest mass selected, click **Edit** on the Design Bar.
19. Click **Void Form>Void Extrusion**.



20. On the Sketch Design Bar, click **Set Work Plane**.

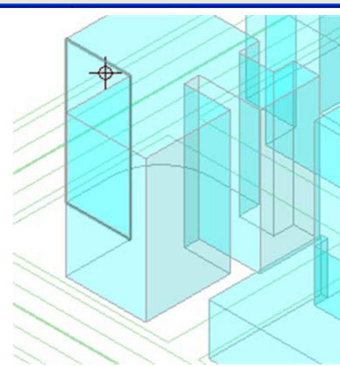


Setting a work plane allows automatic change of the coordinate system in a simple way.

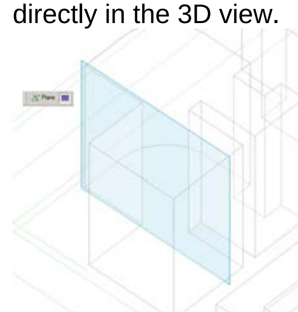
21. The Work Plane dialog box appears. Select **Pick a Plane.**

Select any face, reference plane, or gridline as an active work plane. In the name drop-down are named reference planes, levels, and gridlines.

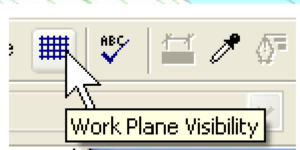
22. Click the vertical face of the mass located on the lower-left block.



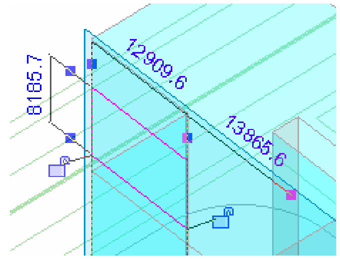
In this case, you are selecting a vertical face directly in the 3D view.



23. On the Design Bar, click the **Work Plane Visibility** button to see the active work plane.



24. Select the Lines tool and draw a rectangle-based sketch. Autodesk Revit Building has automatically changed the relative coordinate system to vertical.



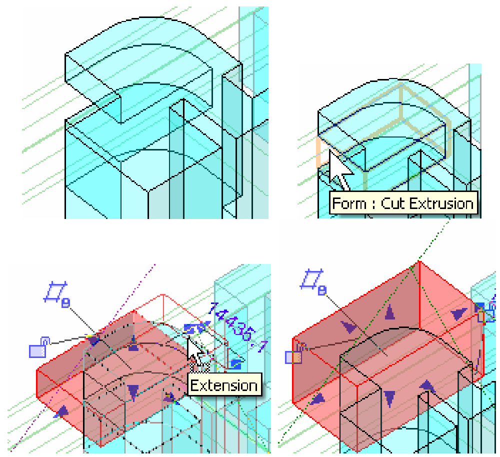
Switch to an elevation view, or create a section if you prefer not to draw in axonometric view.

25. On the Options Bar, set the **depth** of the mass to **20m**.

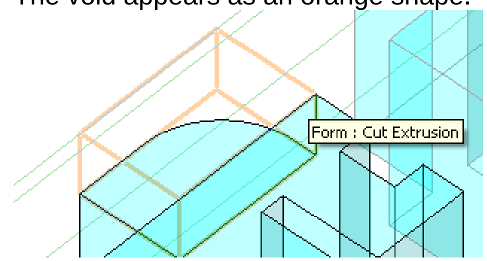
In this case, the depth refers to the horizontal plane, as you are drawing on a vertical plane.

26. Click **Finish Sketch**.

27. Drag the shape handle of the void until it snaps to parallel geometry to make void cut completely through the solid.

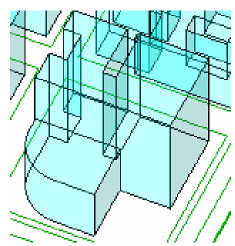


The void appears as an orange shape.

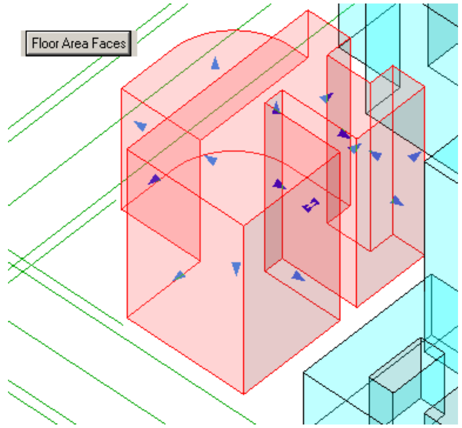


You do not need to be exact with the void. Once you are done with mass sketch mode, the void disappears.

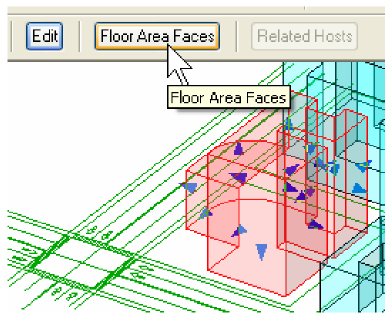
28. Click **Finish Mass** to complete the mass.



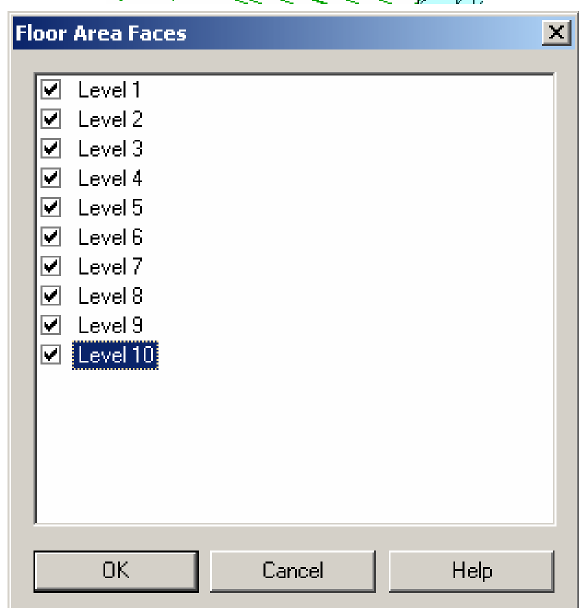
29. Select the southwest massing (the one you have been working with).



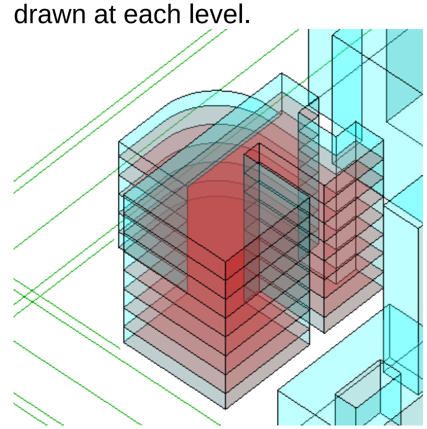
30. On the Options Bar, click the **Floor Area Faces** button.



31. Select the check boxes for all the levels.



Each level that intersects the massing is a candidate for a floor area face. These faces enable you to place floors and do quantity takeoffs from the massing object. Planes are drawn at each level.



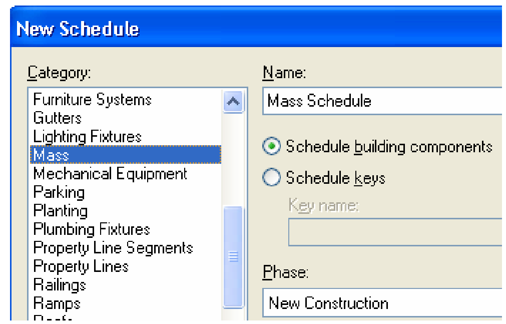
Already at this phase you can get feedback from the building information model such as the total floor area of the floor faces in the design.

Make a Gross Floor Area Schedule

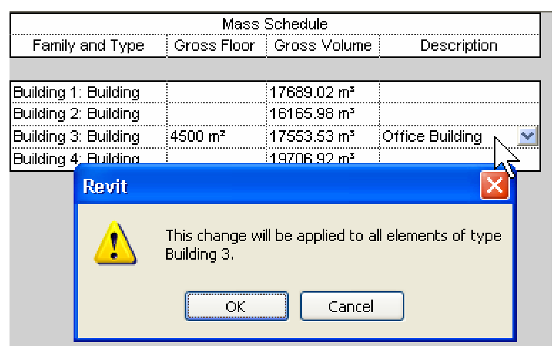
Revit Building provides the ability to get information from the rough mass model, enabling you to dynamically see changes in either the graphical form of the mass, or in the tabular form of a schedule.

For the schedule to work, the floor areas must first be assigned to the mass object.

32. From the View menu, choose the **Schedule/Quantities** tool.
33. Select the **Mass** category.



34. Click OK.
35. Add fields:
    - Family and Type
    - Gross Floor Area
    - Gross Volume
    - Description
36. Click OK.
37. Add a description to Building 3—Office Building and click OK at the type change prompt.



A gross building volume and floor area schedule can be generated and placed in a sheet.

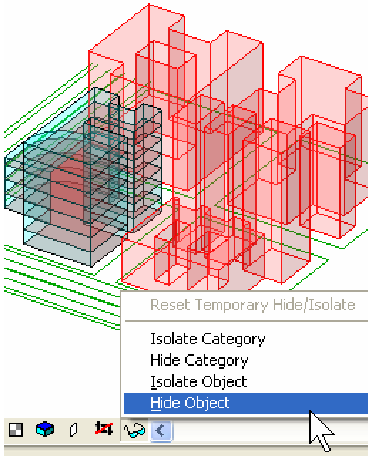
Only the building for which you created the floor areas shows a value in the Gross Floor Area column of the schedule.

Add the Physical Floor Component

The floor areas created previously are simple vertical divisions of the mass that have no thickness. Use the Floor by Face tool to add floors into the mass.

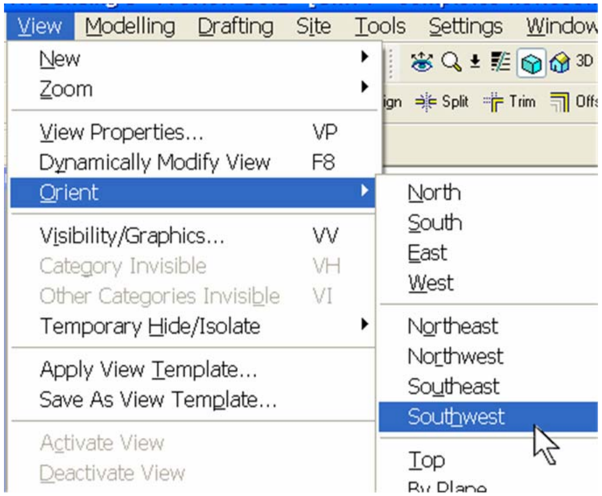
You cannot use the Floor by Face tool until you have the floor faces created.

38. Isolate the southwest building.
    - Open the **3D view**.
    - While pressing the Ctrl key, click each of the three building masses without floor assignments.
    - From the drawing window's View toolbar, click **Hide Object**.

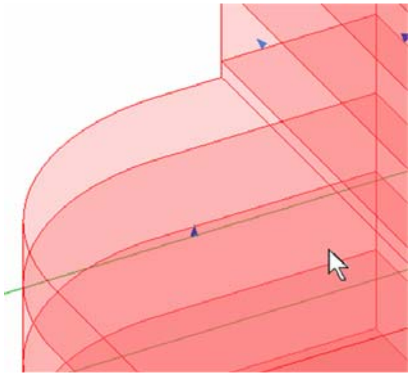


Use Hide Object/Isolate Object to work on one object in the project.

39. Use the View menu to orient the view to the southwest.



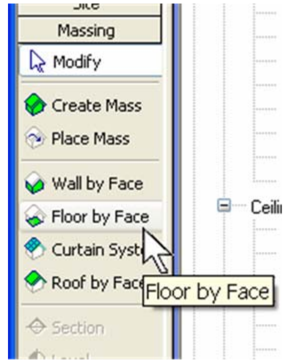
40. Change the height of the lower wing to just under one of the floor area faces.



Add Floors to the Building

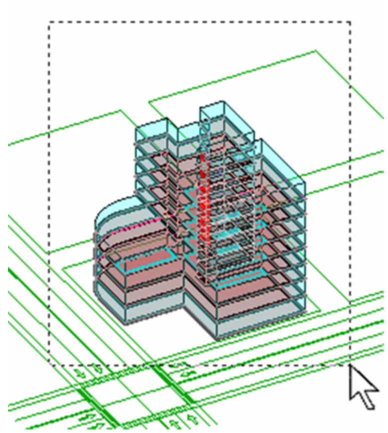
Now that you have created the mass of the building, you can start adding the building elements.

41. On the Massing tab of the Design Bar, select **Floor by Face**.



42. On the Options Bar:
- Set floor type to **Insitu Concrete 225mm**.
- Verify that **Select Multiple** is selected.

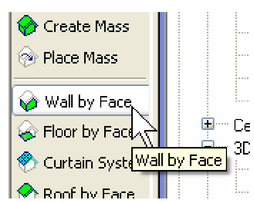
43. Drag a window around the whole building.



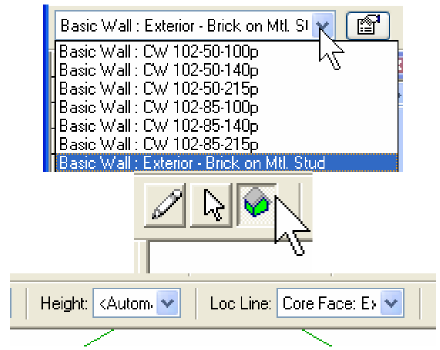
44. On the Options Bar, click the **Create Floors** button.

The floors are automatically generated.

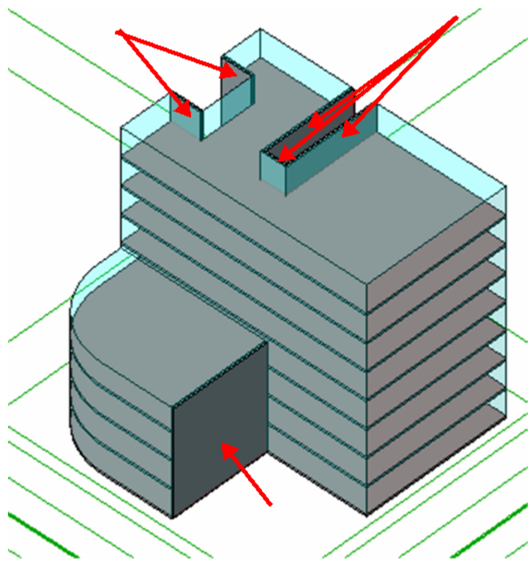
45. On the Massing tab of the Design Bar, click the **Walls by Face** tool.



46. On the Options Bar, set:
- Wall Type = Exterior Brick on Mtl. Stud
- Draw Type = Pick Face (House Icon)
- Height = Automatic
- Loc Line = Core Face Exterior



47. Click the walls shown at right.



Spin the model to select these faces. Hold down the scroll wheel and move the cursor to spin the model.

48. Click the **Show Mass** tool.

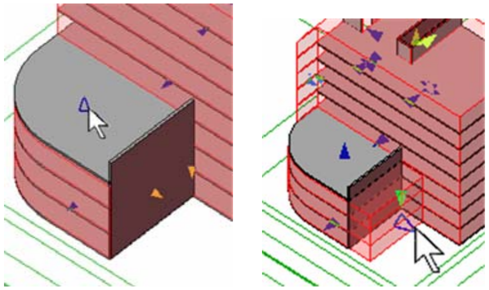
This tool enables you to move back and forth between seeing the massing and the floors and walls or just the floors and walls.

49. Click the **Show Mass** tool to show the mass again.

Adjust the Building Envelope (Massing)

50. Click the **Modify** tool.
51. Select the mass.

52. Use the triangular face grips to modify the lower wing (see illustrations at right):
- Top face down one level
- South face half the distance to the street



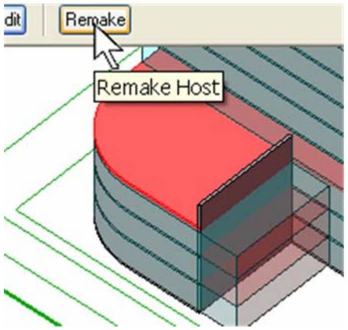
If stray portions of the mass show up as you grip the mass faces, use the Edit button to access sketch mode and adjust the void extrusion to clean up.

53. Click any white area to deselect the building.

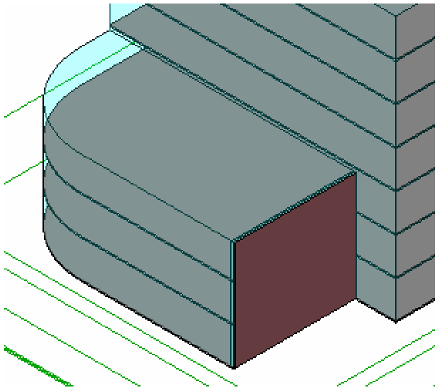
The building elements are now out of sync with the mass model.

Update the Walls and Floors

54. Select the floor exposed by dropping the top face.
55. On the Options Bar, click the **Remake** button.

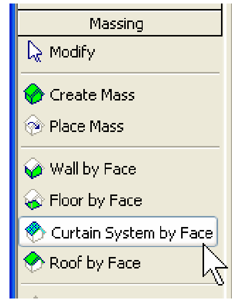


56. Repeat, selecting the south wall of the lower wing.
57. Repeat for the lower three floors.



Add Curtain Wall System

58. On the Massing tab of the Design Bar, click the **Curtain System by Face** tool.

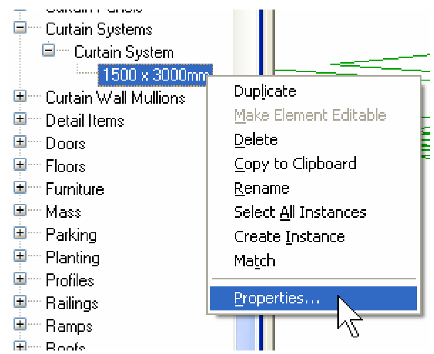


59. Verify that the curtain system is set to 1500 x 3000mm.

60. Select the remaining exterior faces.
61. On the Options Bar, click the **Create System** tool.

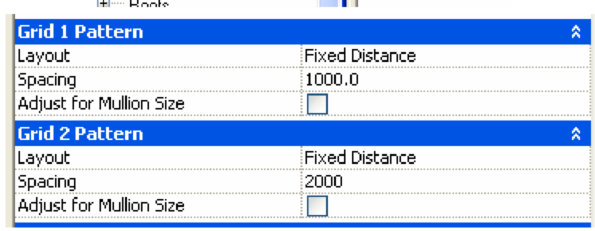
Adjust Curtain Wall System

62. In the Project Browser, expand **Families> Curtain Systems>Curtain System**.
63. Right-click the **1500 x 3000mm** type, and choose **Properties**.



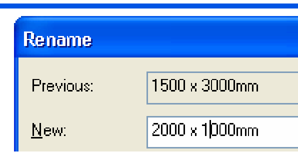
64. In the Type Parameters set the Layout (Grid 1) (vertical spacing of the horizontal grid) to Fixed Distance and 1000.

    Set the Layout (Grid 2) to Fixed Distance and 2000.



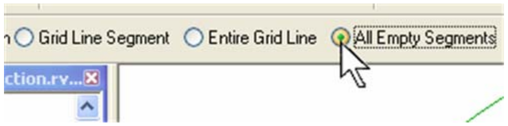
Because you are editing the type, the changes you make apply to all curtain systems in the project.

65. Click **Rename** and enter **2000 x 1000mm** for the name.

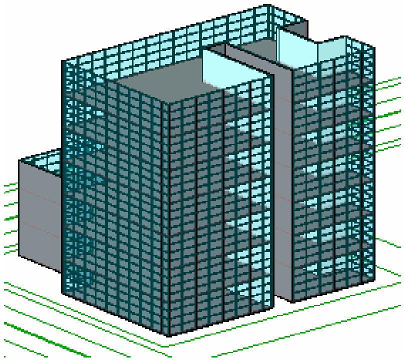


66. Click OK two times to return to the drawing window.

67. From the Modeling tab on the Design Bar, click the **Mullion** tool, and on the Options Bar click **All Empty Segments**.



68. Click a curtain system face of the model.
69. Repeat for the remaining curtain system faces.

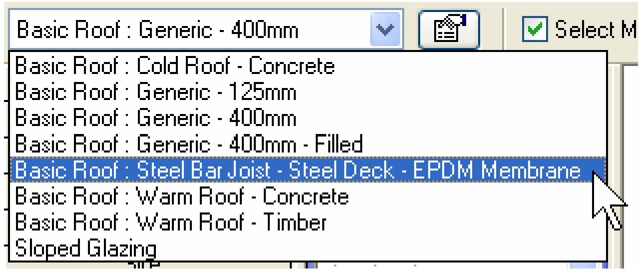


Add Roof

The process of adding a roof is the same as that for adding walls or floors.

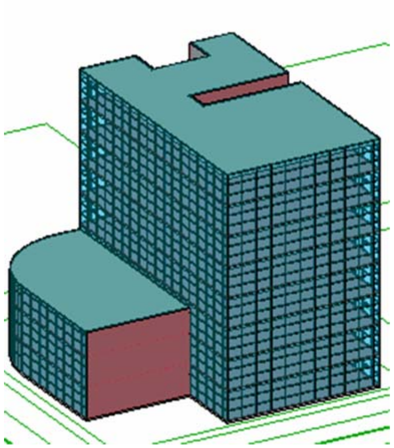
70. On the Massing tab of the Design Bar, click the **Roof by Face** tool.
71. On the Options Bar, set:

- Roof type = **Steel Bar Joist – Steel Deck – EPDM Membrane**
- Level = **9**

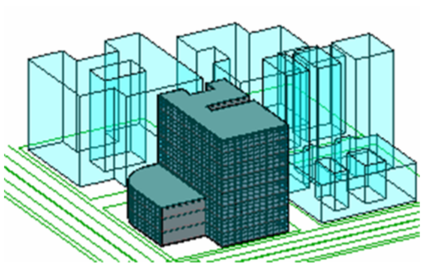


72. Select the top face.
73. On the Options Bar, click the **Create Roof** tool.

74. Repeat, adding a roof at level 3 for the lower wing.



75. On the drawing window view toolbar, click the **Isolate** tool and select **Reset Temporary Hide/Isolate**.



Note that if you come back to this project later, you may have to click the Show Mass tool to see the mass elements. Show Mass is not turned on by default in a new session.

Unit 9, Exercise B: Importing SketchUp Files

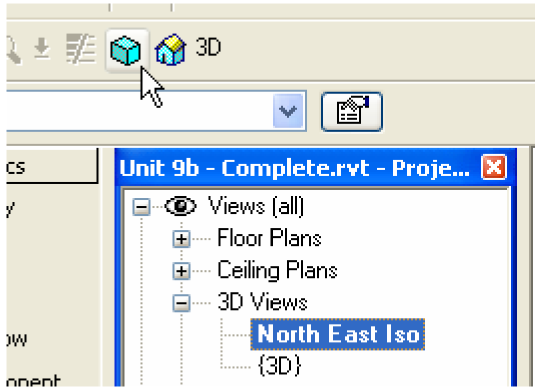
In this exercise you import a SketchUp file directly into the project as well as import a SketchUp file into a mass family as it is created.

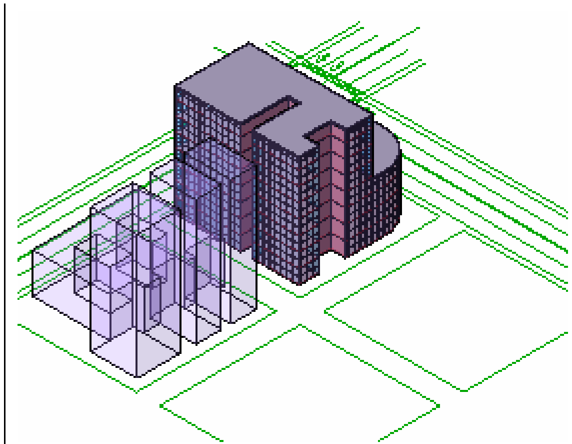
Exercise Setup

1. Open file: Unit 9b – Start.rvt.

2. Set the view **3D Views>North East Iso** current.

3. Click the **Show Mass** tool on the toolbar.



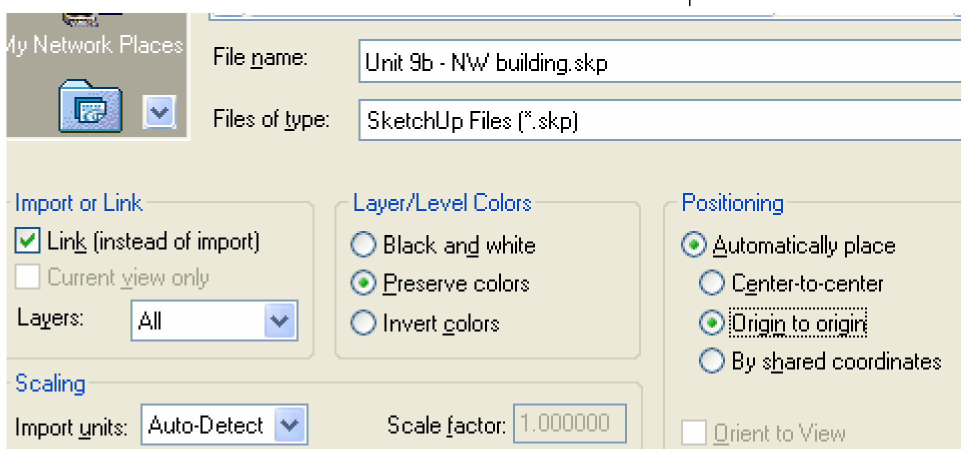


Import a SketchUp Model

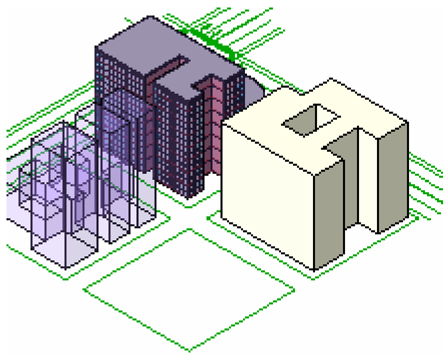
4. From the File menu, choose **Import Link>CAD Formats**.

5. In the Import/Link dialog box, set:

   a. Files of Type = SketchUp
   b. File Name = Unit 9b – NW building.SKP
   c. Select Link (Instead of Import)
   d. Click Preserve Colors
   e. Click Origin to Origin



6. Click Open



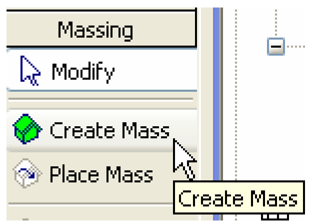
The SketchUp model is read into the Revit Building project.

Import a SketchUp Model into an In-Place Mass Family

While the SketchUp model is displayed in the Revit Building project, it acts as a solid block. If you want more flexibility with the SketchUp model, you can import it into an in-place mass or a Revit mass family (RFA).

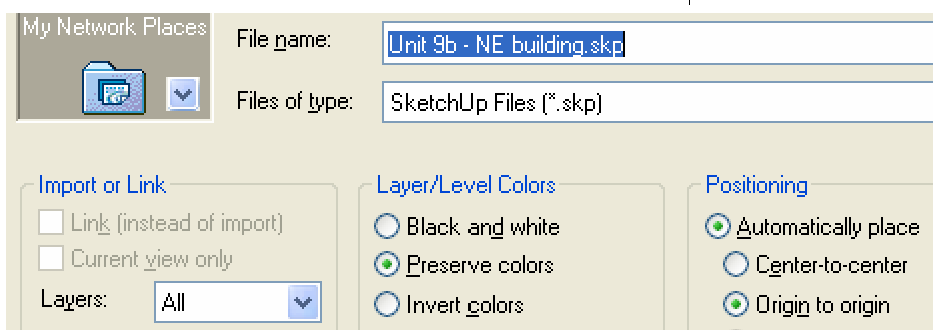
Once the SketchUp file is nested inside a mass, you can use the Building Maker features as explained in Unit 9, Exercise A.

7. Click the Create Mass tool to start the In-Place Mass routine.



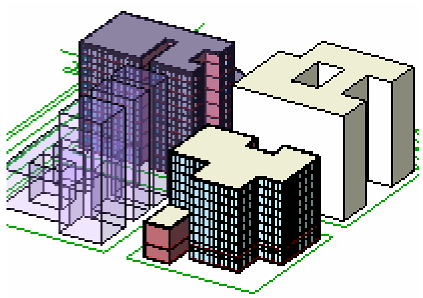
8. Name the new mass **Building 5**.

9. Repeat the steps in the first part of this exercise to import a SketchUp model. Import the SketchUp file: **Unit 9b – NE building.skp**.



10. On the Design Bar, click the **Finish Mass** button.

11. Apply walls, floors, and roof of your choosing.



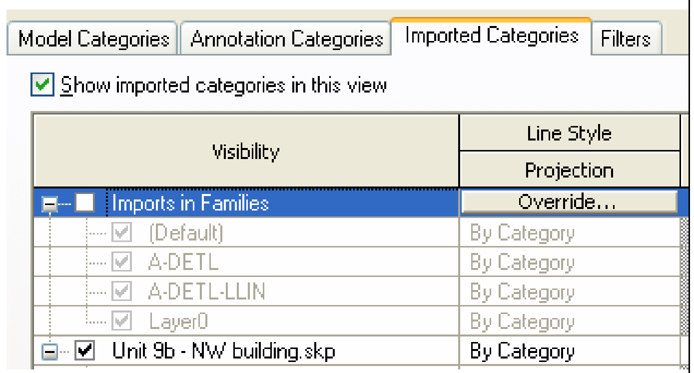
If you need assistance with this process, review the previous exercise for step-by-step instructions on applying walls, floors, and roofs to faces of the mass (Building Maker functions).

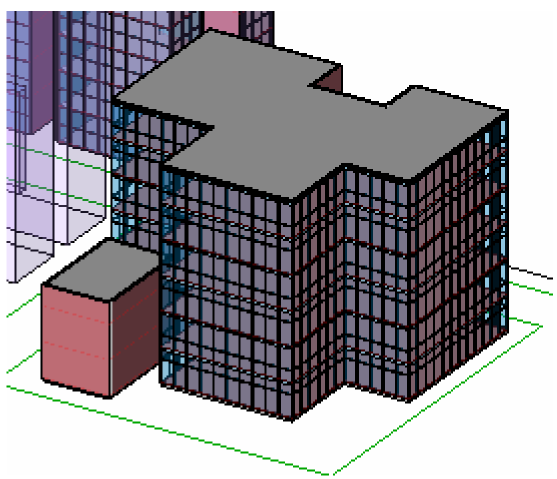
Turn off the SketchUp Model

As with any other imported file, you have control over the visibility of the graphics of the linked file.

12. Type **VV** to access the views graphic overrides.

13. Clear the **Imports in Families** check box.





Unit 10

Theory: Component Design

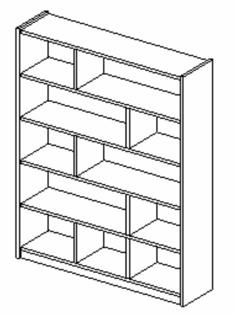
Autodesk Revit Building: Family Editor

This workbook unit is to be used with Lecture Units 10 and 11. Unit 10 builds a shelf unit as a furniture family using solids. This shelf is the basis for the multiple exercises in Unit 11. This exercise is long, so give yourself enough time to finish it, or save it in a location that you have access to later.

This exercises uses dimensions and align tools extensively. You should be familiar with these tools before you start this exercise.

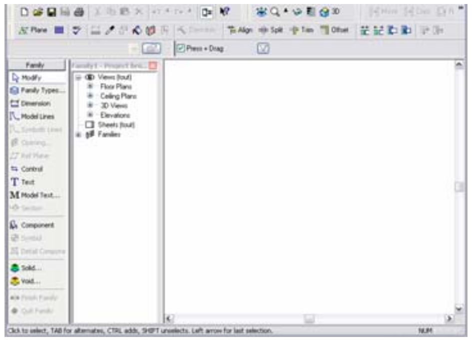
Exercise 10: Creating a Component Family

In this unit you create a furniture family, as shown in the image.



1. From the File menu, choose **New>Family**.

2. In the dialog box, open the template called **Metric Furniture.rft**.



The Family Editor opens: note that the work environment is similar to the project mode. The Design Bar provides just one Family Bar. The usual bars are not available (Site, Modeling, Structural, and so forth) because they are not used for family creation. The Project Browser does not differ much: there are plan views, elevations (which are named differently), and the 3D views. In the menus, some tools are not accessible (dimmed).

3. Save this file:
   - From the File menu, choose **Save As**.
   - Browse to the data set folder that contains the workbook exercise files.

Note: The completed RFA files for Units 10 and 11 are in the *Completed rfa* folder here. The other shelf units in this folder are starting points for Unit 11 exercises.

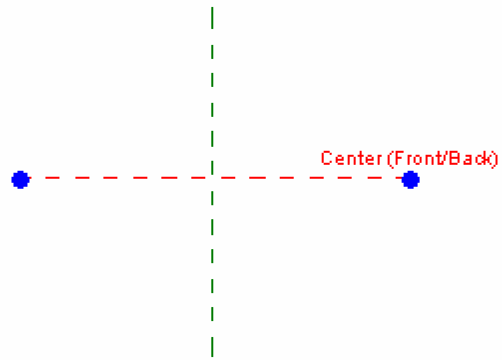
- Open the RFA folder in this location.
- Save this file as **Unit 10 Shelf Unit**.

Create Overall Reference Planes

When you are working with families, you are creating reference planes. These reference planes are assigned the parameters that drive the geometry.

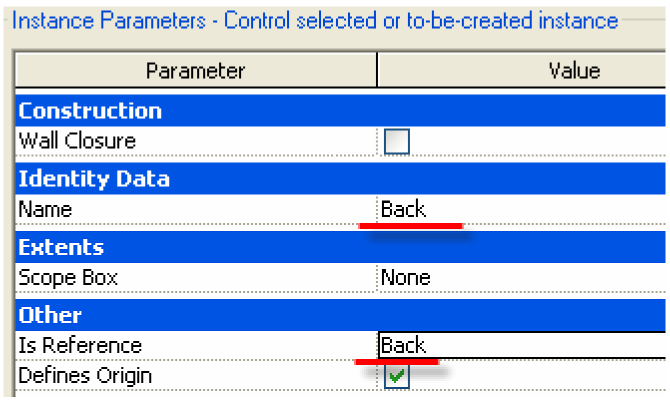
4. In the Project Browser, open **Floor Plans>Ref Level**.

5. Right-click the **horizontal reference plane** and choose **Properties**.



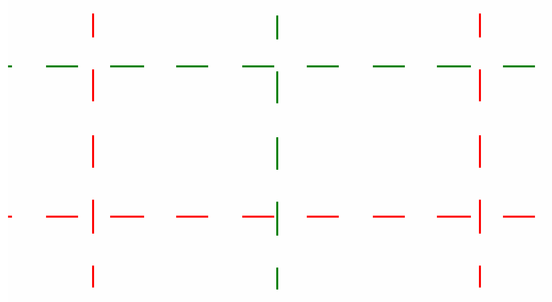
In this view there are two reference planes. The intersection of these two planes represents the insertion point of the family. In this case, this point is the rear (back) and the middle of the piece of furniture. Begin by changing the name of this reference plane.

6. In the Properties dialog box, change the name to **Back** and verify that **Is Reference**: **Back** is selected. Click **OK** to exit.



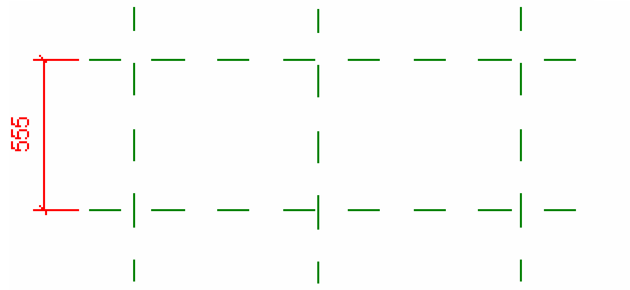
Reference planes are important in the creation of families. It is on these lines that you base the parameters of your family; they are references for the geometry. Adding reference planes is easy. Simply specify a starting point and a final point (just like drawing a line). The length of the line symbol is not important. If necessary, you can resize it using the grips that appear at its ends when it is selected.

7. Click the reference plane button on the Design Bar and add three planes, as shown in image (don’t worry about the distances between each plane).

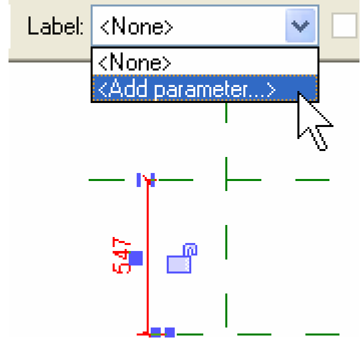


You must be able to vary the width and depth of your piece of furniture, so you add two new parameters to your family. To create a parameter you must add a dimension and assign it a label. The depth of the furniture family corresponds to the distance between the two horizontal reference planes; the width corresponds to the distance between the two vertical reference planes (right and left).

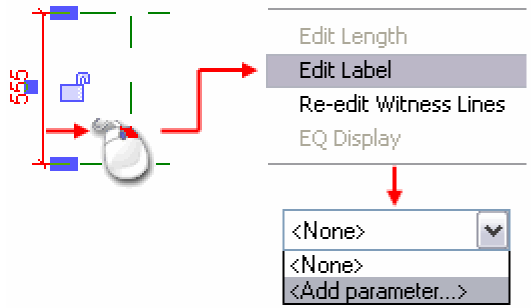
8. On the Design Bar, click the **Dimension** button, and add a dimension line between the two horizontal reference planes.



9. On the Design Bar, click the **Modify** button and select the dimension. On the Options Bar, from the **Label** list select **Add Parameter**.



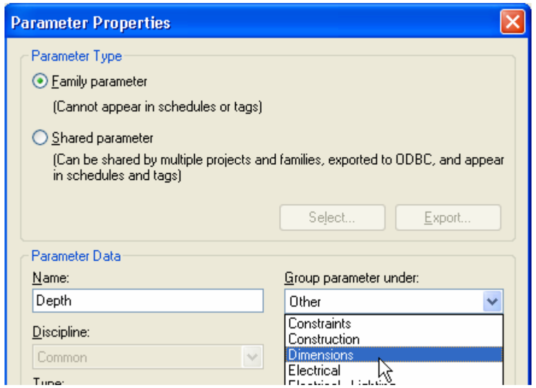
You can also right-click the dimension line and choose Edit Label from the context-sensitive menu.



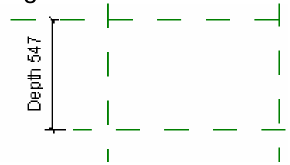
10. In the Properties dialog box for the parameter, enter **Depth** as the name. The options suggested by default are that this is a **Type** parameter.

11. Set the Group Parameter Under to Dimensions.

12. Click **OK**.



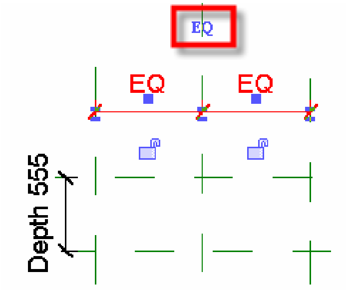
The Group Parameter Under setting is an organizational structure for the parameters.



A dimension that is associated with a label (parameter) displays the parameter name in the dimension string.

13. On the Design Bar, click the **Dimension** button and add a dimension between the **three vertical reference planes** (click each line and position the dimension line with a left mouse-click).

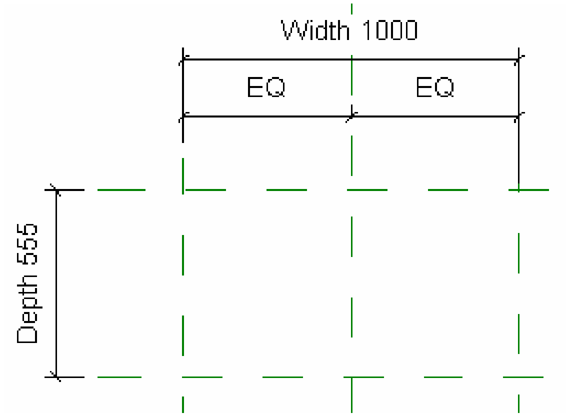
14. Click the **EQ** symbol that appears.



The vertical reference plane between the two other planes is the axis of the furniture. Thus, it must be equidistant between the planes on the right and left. To achieve this and keep it as a constant during the design, you need to add a dimension between the three reference planes and activate the equality constraint (symbol EQ).

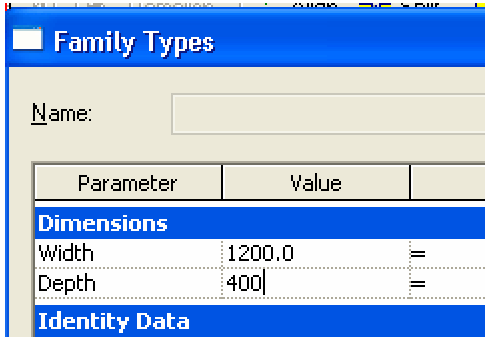
15. Repeat the earlier steps to add the **width** parameter.
    - Add a dimension (between two outside vertical reference planes).
    - Click dimension, and then click **Add Label** on the Options Bar.

    Set the label:
    Name = **Width**
    Group = **Dimensions**
    Type parameter



16. On the Design Bar, click the **Family Types** button, change the **Depth** and **Width** values, and then click **Apply**.

17. Click **OK**.



During family design, it is important to test the parameters to check that all is working properly. You have just added two parameters in your family. You can test them by changing some of their values. During this test, reposition the reference planes. You should not receive any error message.

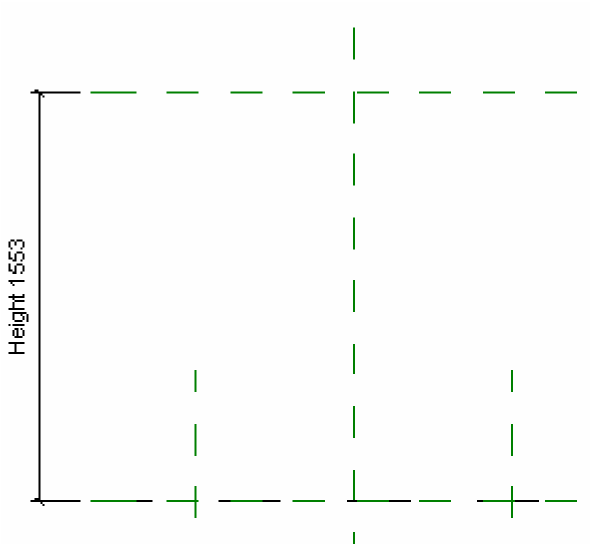
This is called *flexing the family parameters*.

18. In the Project Browser, click **Front** view.

19. Add a horizontal reference plane, add a dimension between the reference plane on the ground and the one you have just added, and transform this dimension into a parameter named **Height** (also a type parameter in the Dimension group).

20. Flex the family by changing parameter values in the **Family Types** dialog box.

21. Save your project.



Remember to save your work regularly. You can decide to create a new tree structure of files under the main *Library* folder. It's a good idea to keep your personal libraries separate from the installed library.

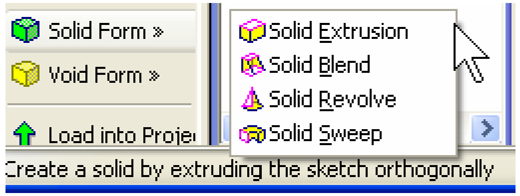
Create Side Supports

Now that the reference planes are in place the side supports are created with the solid extrusion tool.

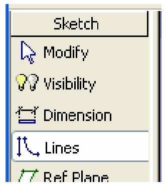
22. Activate the view **Ref. Level**.

23. On the Design Bar, click the **Solid** tool, and choose **Solid Extrusion** from the flyout.

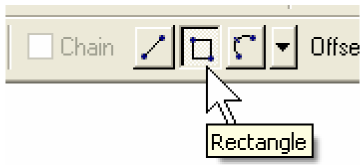
Sketch mode is used for creating forms. The Design Bar displays the tools available to create the sketch, which must be a closed loop.



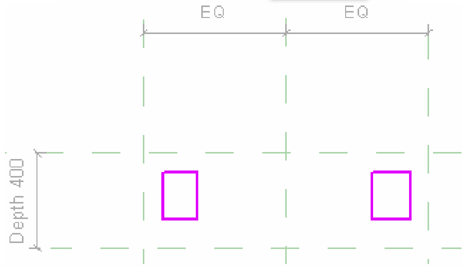
24. On the Design Bar, click the **Lines** button.



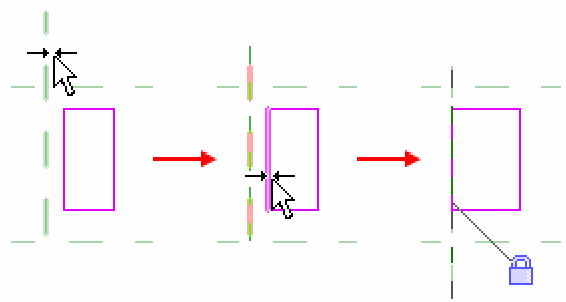
25. On the Options Bar, click **Rectangle**.



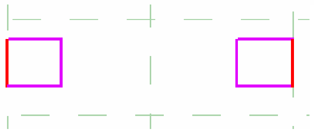
26. Trace two rectangles, as in the image (the size is not important).



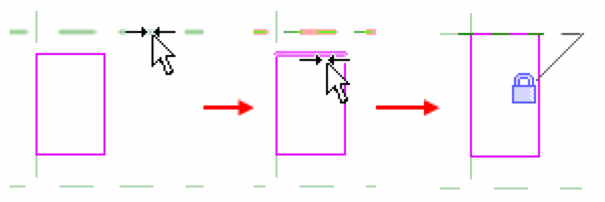
27. Use the Align tool to lock the left sketch line to the left reference plane, as in the image.
    - Click Align tool.
    - Click left reference plane.
    - Click left line of the left rectangle sketch line.
    - Lock this alignment by closing the lock symbol that appears (click the symbol).



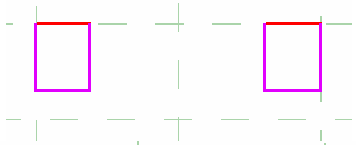
28. Repeat the process for the right rectangle, locking the right edge to the right plane.



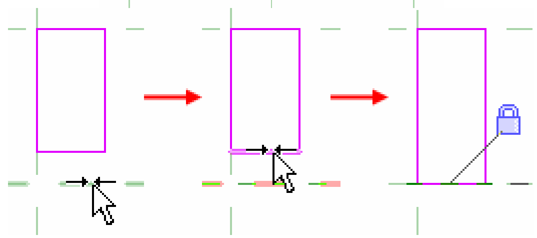
29. Use the **Align** tool to lock the top left sketch line to the top reference plane, as in the image.
    - Click Align tool.
    - Click top reference plane.
    - Click top line of the left rectangle sketch line.
    - Lock this alignment by clicking the lock symbol.

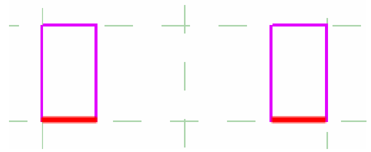


30. Repeat the process for the right rectangle top sketch line.

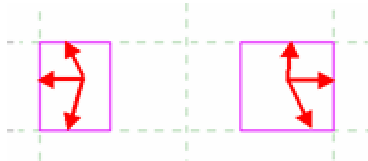


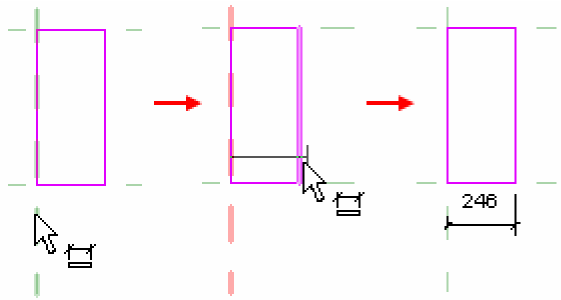
31. Repeat this process for the bottom sketch lines, locking them to the lower reference plane.





The sketch lines shown here should now be aligned/locked with their respective reference planes.





When you dimension a sketch like this, you want to run the dimension to the reference plane rather than the sketch line.

This allows the sketch to flex as you use the dimensioned label parameters to drive the reference plane geometry.

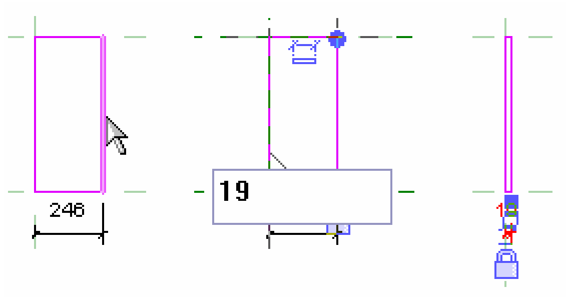
32. Click the **Modify** tool.

33. Select the sketch line on the right side of the

rectangle you just dimensioned.

34. Click the dimension text and change the value to **19mm**.

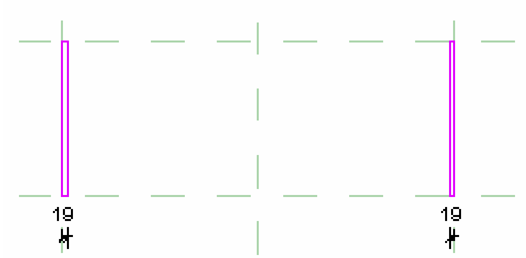
35. **Lock the dimension** by clicking the lock symbol.



36. Repeat the process for the sketch on the right side.

37. Click **Finish Sketch**.

38. Save the family.

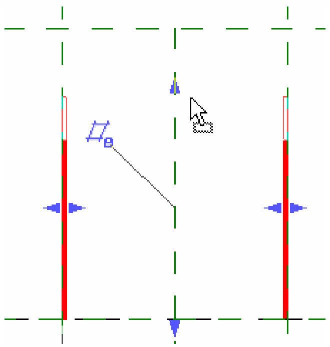


39. In the Project Browser, select **Front** view.

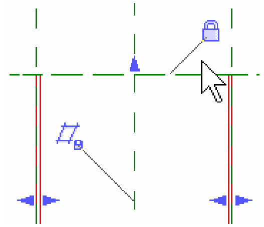
40. Select the 3D geometry. Blue grips that can be used for dragging the faces appear.

41. Drag the grip that allows changing of the height of the solid element until you reach the top reference plane.

42. Click the **lock symbol** to lock the alignment.

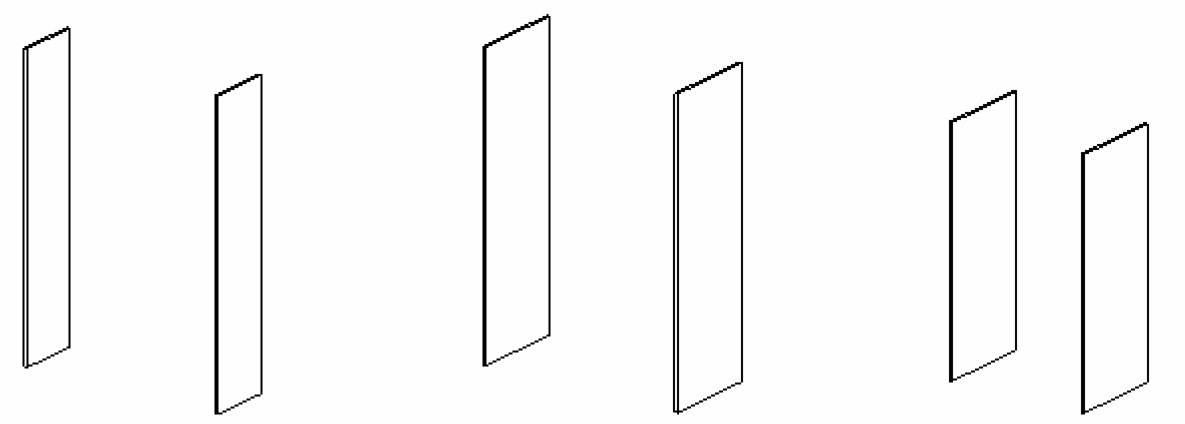


You can also use the Align tool to accomplish this task.



Because you drew two rectangles in the sketch mode, you have only one vertical grip that controls the height of both side frames.

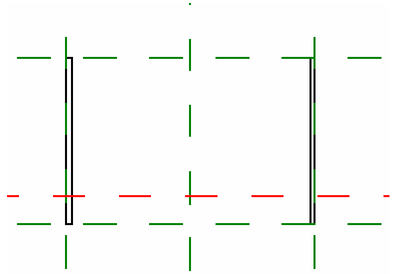
43. The vertical sides are finished. Test your work by varying the parameters of the family (width, height, depth) in the **Family Types** window (flexing the model). The 3D geometry must update consequently and no error message should appear. To see the effect of the parameters well, open a **3D** view.



Create Reference Planes for the Shelves

44. Open view **Ref**. **Level** in the Project Browser.

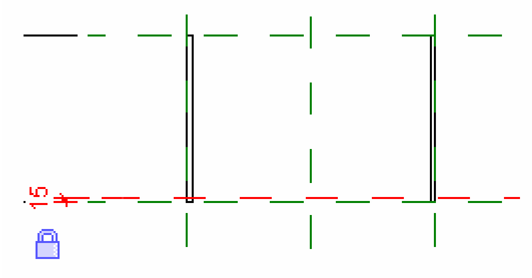
45. Add a horizontal reference plane just above the one that defines the **depth** of the furniture family.



46. Add a new dimension line between the bottom reference plane and the one you just created.

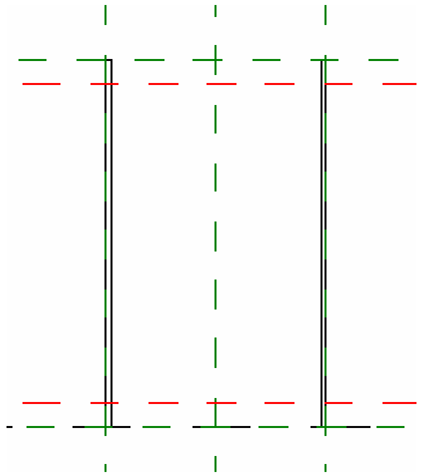
47. Select the reference plane and change the dimension text to **15mm**.

48. Lock the dimension.



49. Open the **front** view.

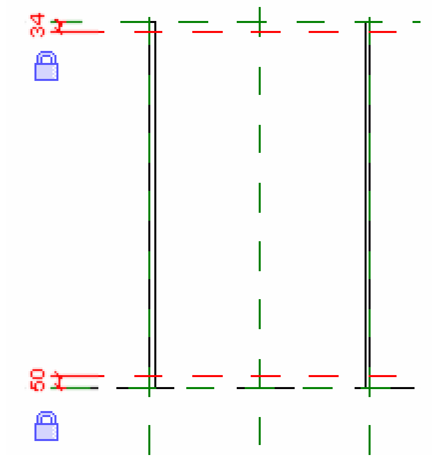
50. Add two horizontal reference planes, as shown in the image.



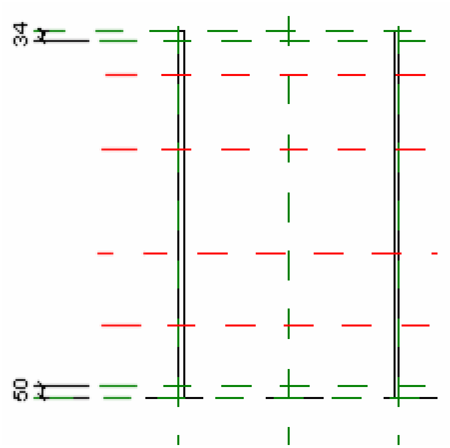
51. Add the two dimension lines, as shown in the image.

52. Set the top dimension value to **34mm** and the bottom one to **50mm**.

53. Lock the dimension lines.



54. Add four more reference planes, as shown in the image.

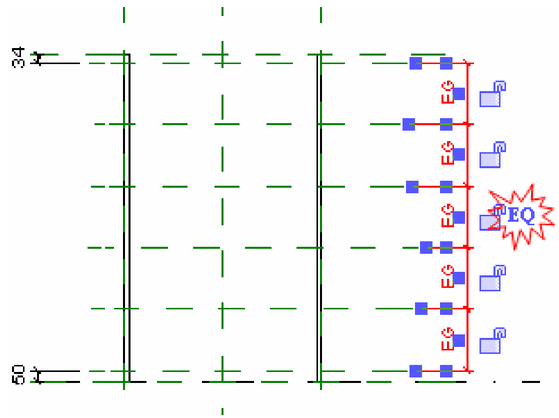


55. Click **Dimension** and then click the four reference planes, as well as the two created in the previous step.

56. Click the **EQ** symbol.

57. **Flex the model** by changing parameter values.

58. **Save** the file.

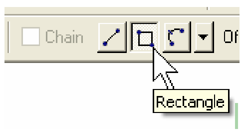


A few words to explain these reference planes: two of them cannot move. They are constrained by locked dimensions (50 and 34). The other four are spaced regularly because of the dimension line that constrains the distance between them. Thus, if the height of a piece of furniture is modified, the top and bottom parts are fixed, whereas the distance between the four other planes is adjusted to satisfy the equality constraint.

Add Base Trim

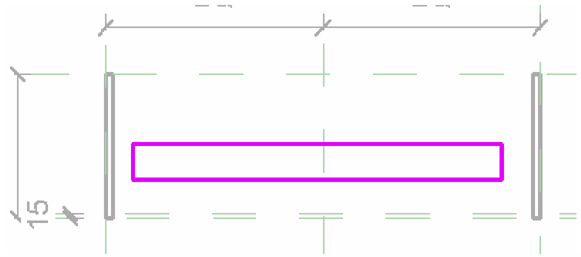
59. Open view **Ref. Level**.

60. On the Design Bar, click **Solid Form>Solid Extrusion**.



61. On the Design Bar, click **Lines**, and then on the Options Bar, click the **rectangle** template.

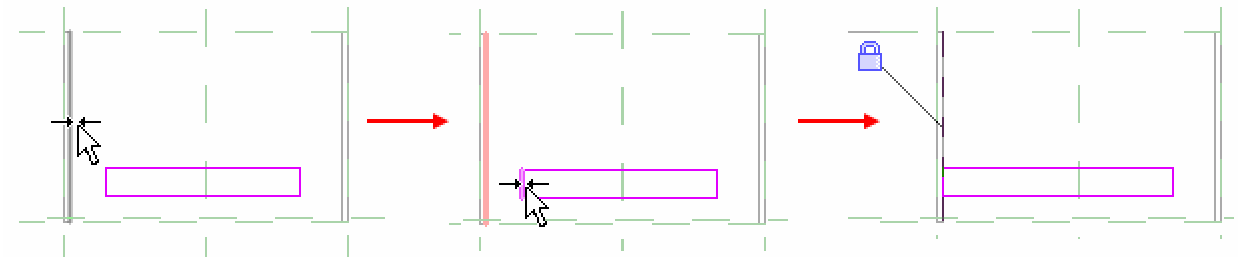
62. Draw a rectangle, as shown in image. The size is not important.



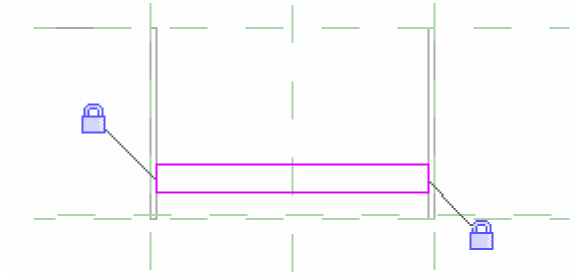
63. Click the **Align** button on the toolbar.

64. Click the internal face of the upright and then click the nearest line of the rectangle.

65. Lock this alignment by clicking the lock symbol to close it.

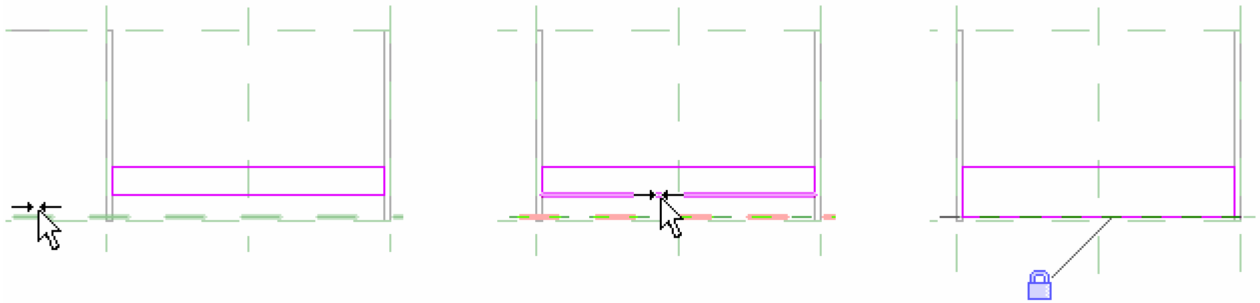


66. Repeat the process on the right side. Don't forget to lock the alignment.



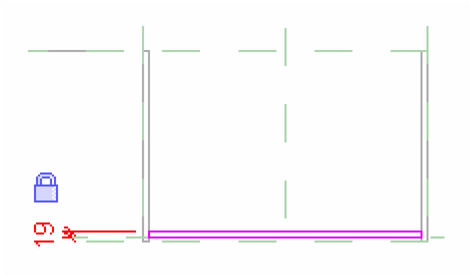
67. With the **Align** tool, click the horizontal reference plane on the bottom and then click the nearest horizontal line of the sketch.

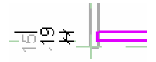
68. Lock this alignment by clicking the lock symbol to close it.



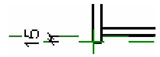
69. Add a dimension between the reference plane immediately above the one that defines the depth and then on the line that you did not lock.

70. Select the line, and in the dimension text change the value to **19mm**.





Notice when you finish the sketch that the dimension disappears.



It is still there when you edit the sketch. This is a useful way to keep your families free from extra dimension clutter but can make it difficult to track when a family gives you overconstrained errors.

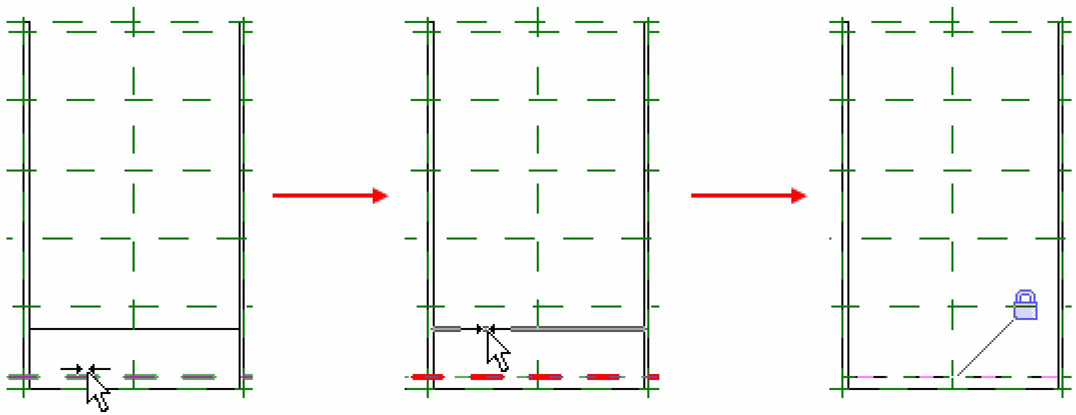
71. Select the dimension and lock it.

72. Click **Finish Sketch**.

73. Open the **front** view.

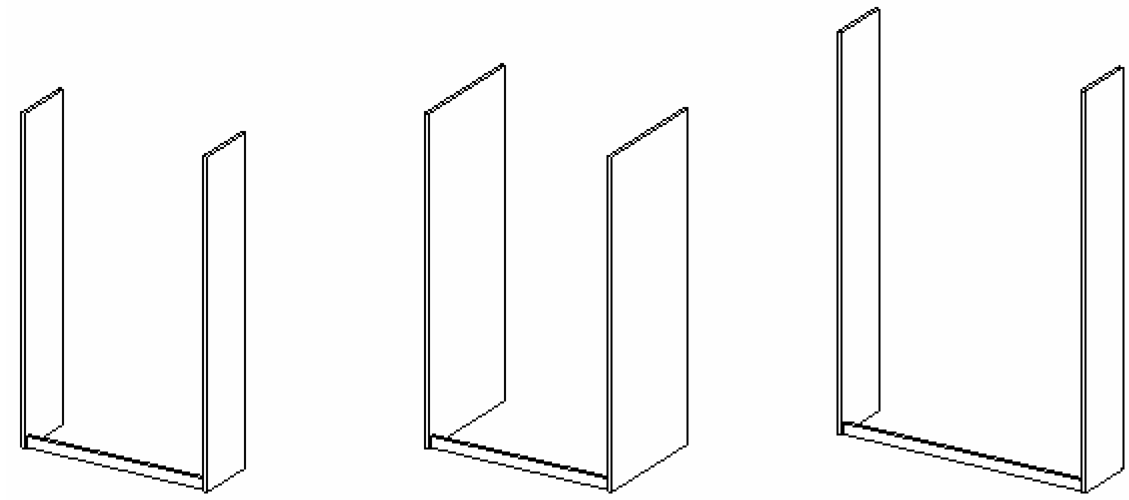
74. Click **Align**.

75. Click the reference plane that is directly below the top of the solid you just created, and then click the top of the solid. Lock the alignment by clicking the lock symbol.



76. Flex the model.

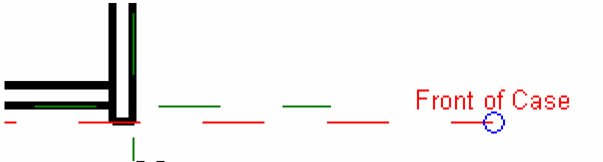
77. Save the family.



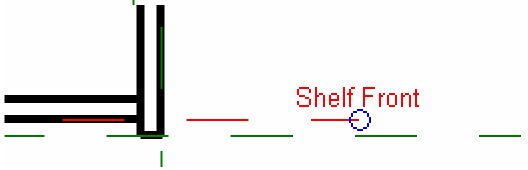
Add Shelves

78. Open Ref Level.

79. Right-click the lowest horizontal reference plane, and choose **Properties**.
80. Rename the reference plane to **Front of Case**.



81. Repeat and rename the second reference plane **Shelf Front**.



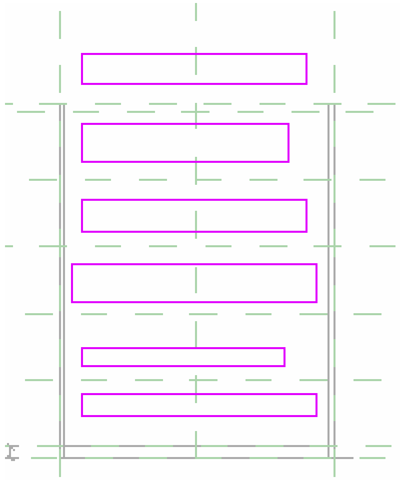
We refer to these reference planes now by these names.

82. Open the **front** view.

83. On the Design Bar, click **Solid Form>Solid Extrusion**.

84. On the Design Bar, click **Lines**, and then on the Options Bar, click the **rectangle** template.

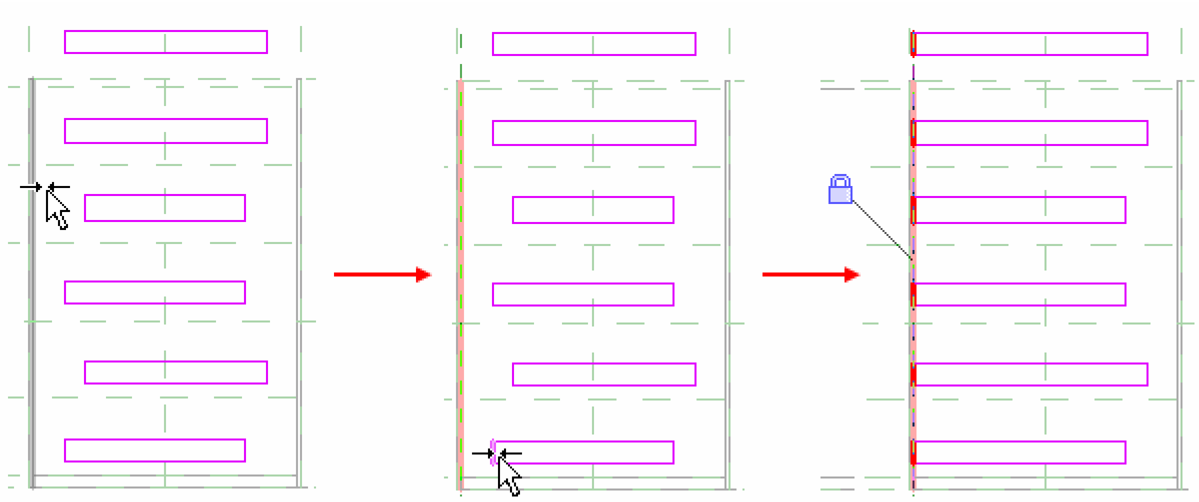
85. Draw six rectangles, as shown in image. The size is not important.



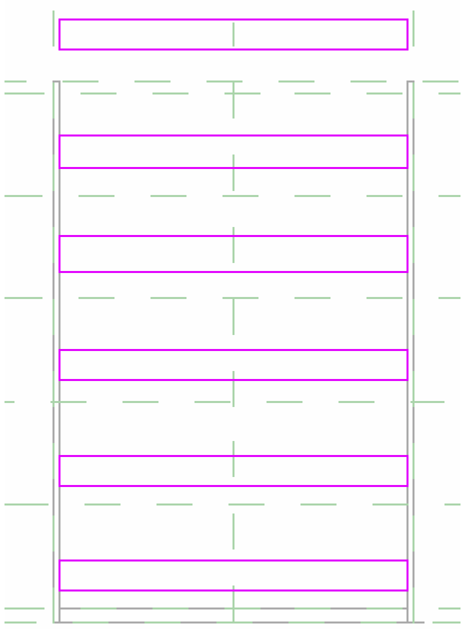
86. Click the **Align** tool, and on the Options Bar, click **Multiple Alignment**.

87. Click the interior face of the left upright and then click the left vertical lines of the rectangles (one at a time).

88. Lock each alignment (you must lock each line individually after aligning it).



89. Repeat the process for the lines on the right side. Remember to lock the alignments.

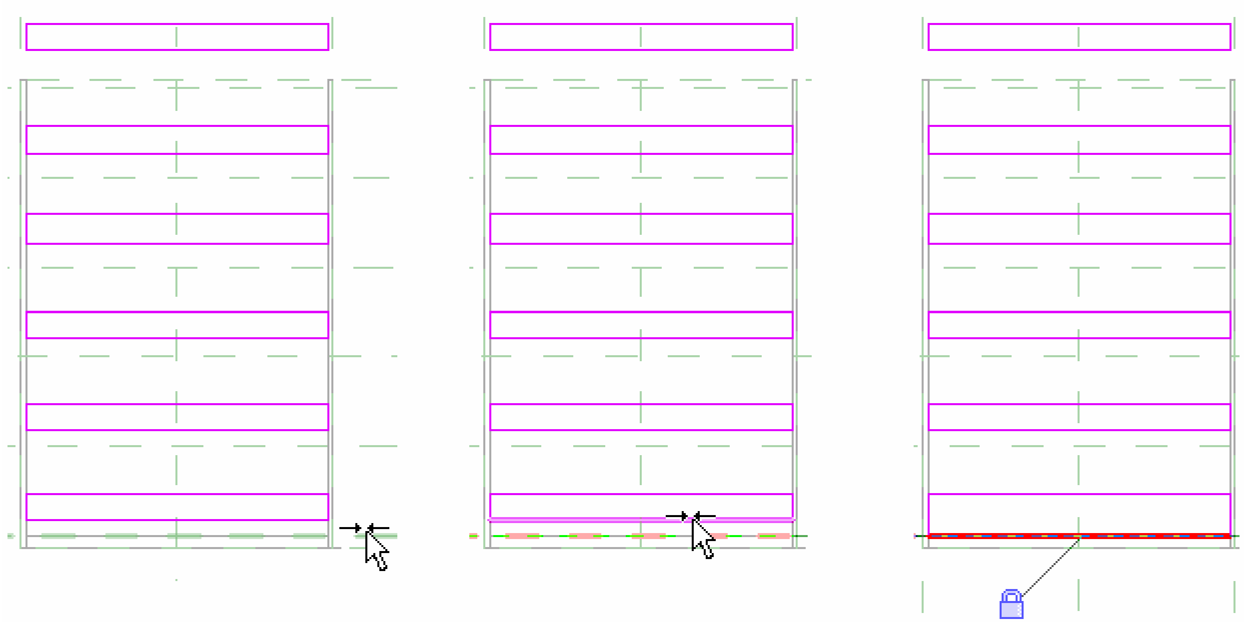


These alignments allow the horizontal racks to remain in contact with the vertical uprights if the furniture family's width is resized. You should now force the horizontal lines of the rectangles; the lines of the bottom of the rectangles must be respectively aligned with the reference planes that are subjected to the equality constraint.

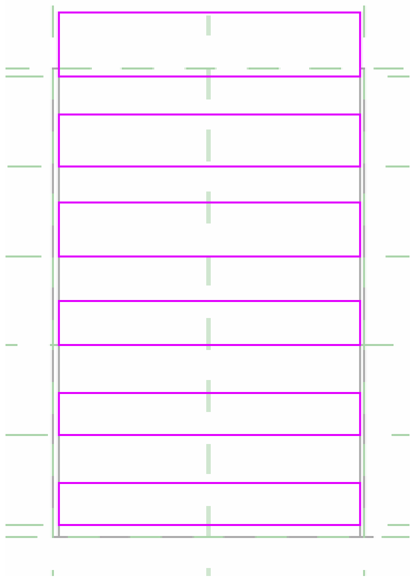
Then you need to place a dimension between each reference plane and the top line of the rectangles: one adjusts dimension and one locks the dimension. Thus, if the height of the furniture changes, the racks cannot vary in thickness. Thanks to the equality constraint, they reposition themselves correctly to divide the obtained space.

90. Click the **Align** tool, and on the Options Bar, clear the **Multiple Alignment** option.

91. Click the reference plane right above ground level and then on the bottom horizontal line of the lowest rectangle. Lock the alignment.



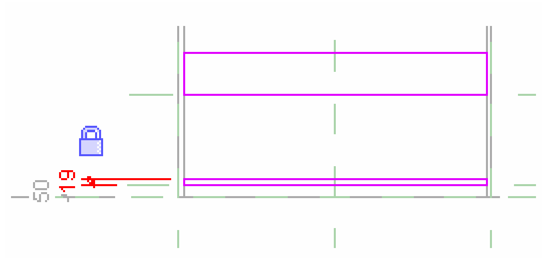
92. Repeat the alignment process with the horizontal reference planes and the bottom lines of the rectangles, as shown in image.



93. Add a dimension line between the reference plane and the top line of the rectangle located on the bottom, as shown in image.

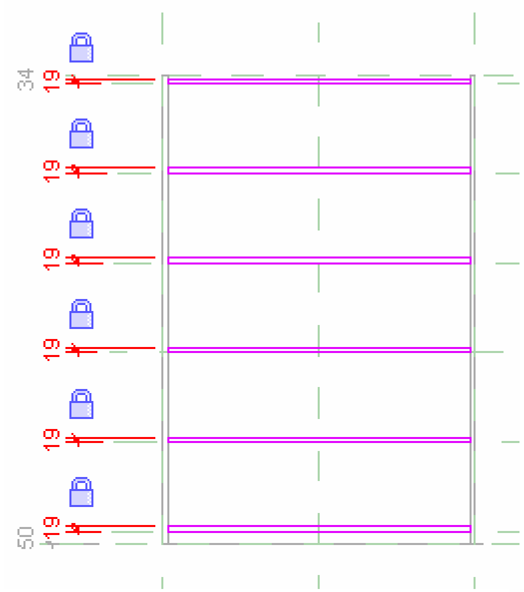
94. Select the line and change the dimension text to **19mm**.

95. **Lock** the dimension.



96. Repeat the process for all horizontal lines (located on the top of the rectangles). Remember to lock the dimensions.

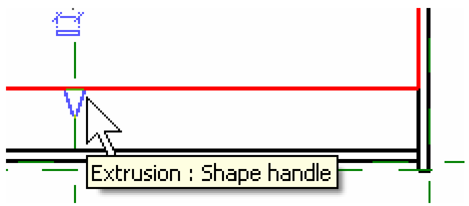
97. Click **Finish Sketch**.

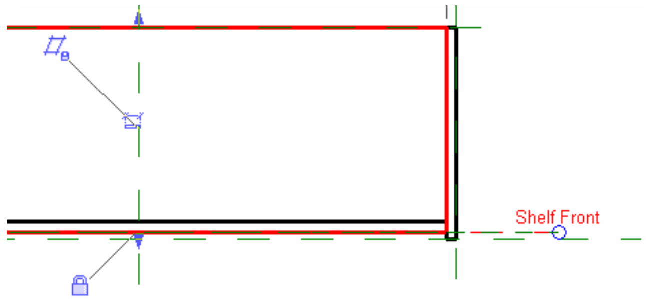


98. Open **Ref. Level**.

99. Select the 3D geometry, as shown in image. The blue grips appear.

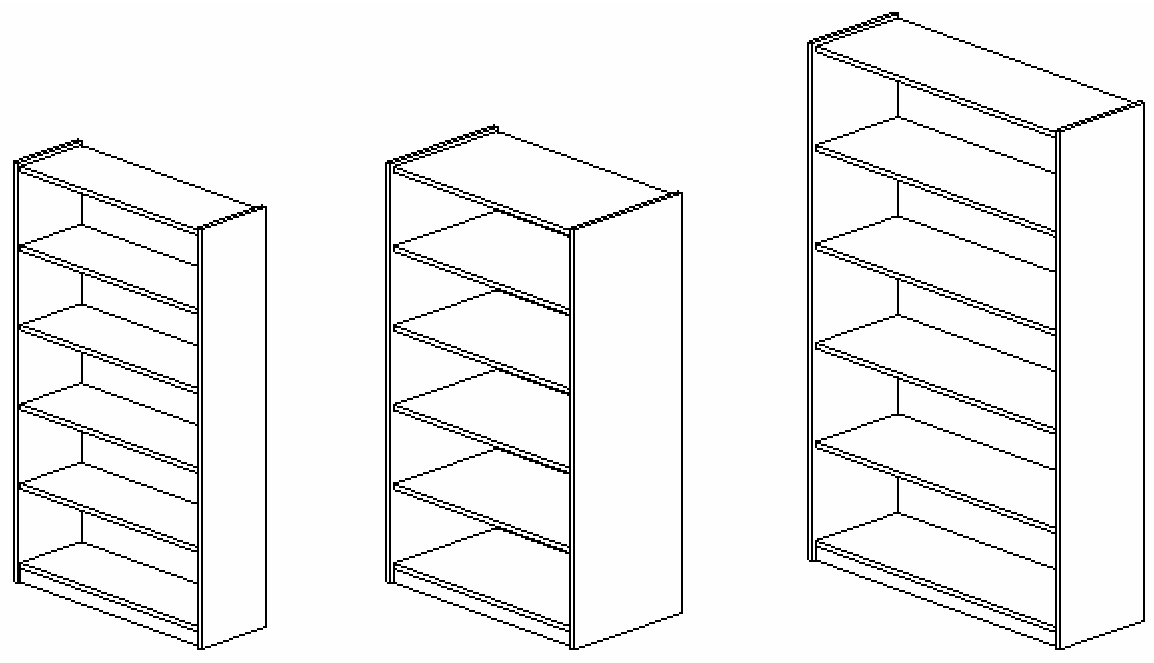
100. Drag the lower blue grip to the reference plane **Shelf Front,** as shown in image. Click the lock symbol. If the lock symbol does not appear, use the **Align** tool.





101. Flex the model.

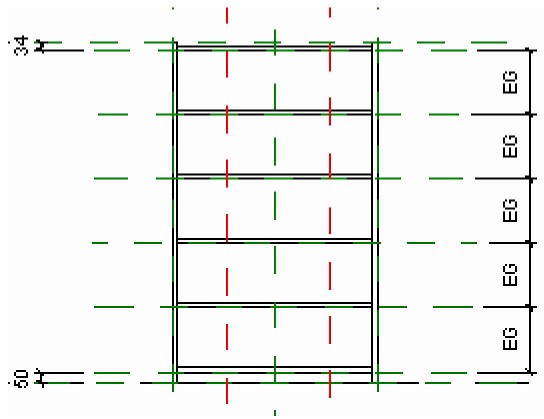
102. Save the family.



Add Vertical Supports

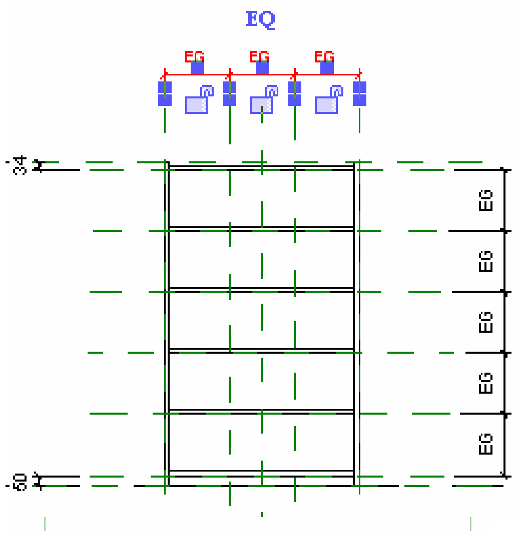
103. In the Project Browser, open **front view**.

104. Add two vertical reference planes, as shown in image.



105. Add a dimension line between the two reference planes you just added and the ext,ernal ones, as shown in image.

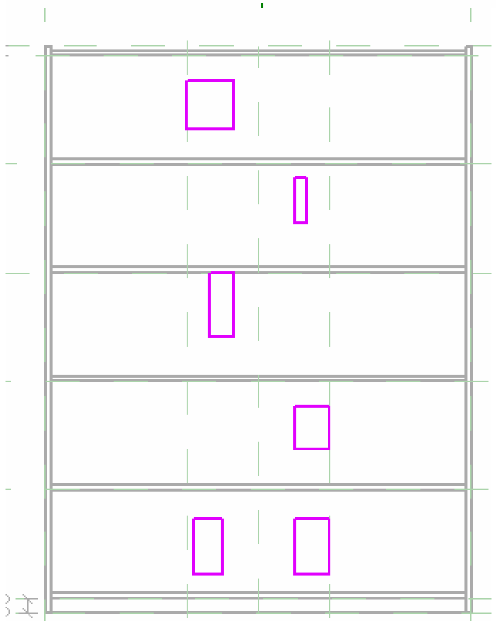
106. Click the **EQ** symbol.



107. On the Design Bar click **Solid Form>Solid Extrusion**.

108. On the Design Bar, click **Lines**, and then on the Options Bar click the **rectangle** template.

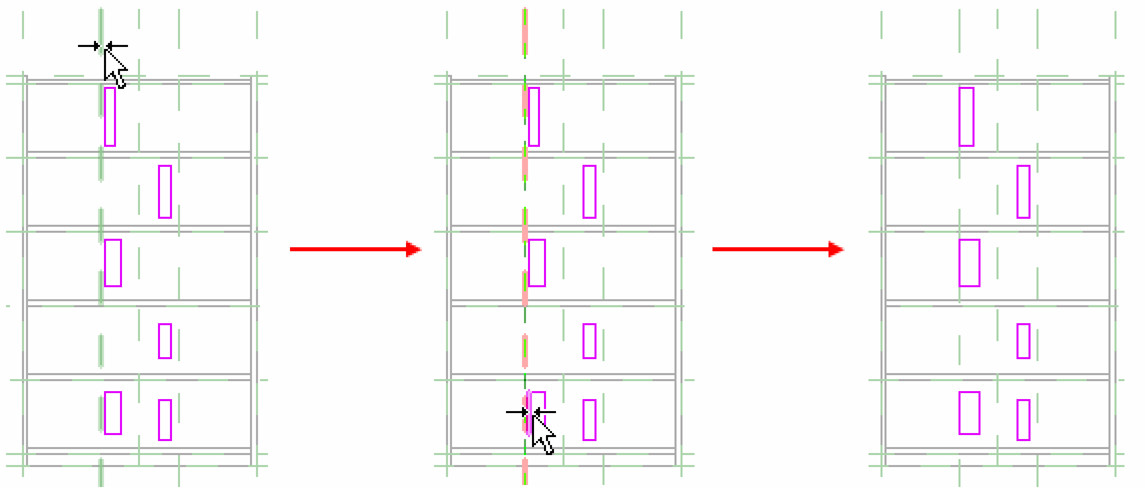
109. Draw six rectangles, as shown in image. The size is not important.



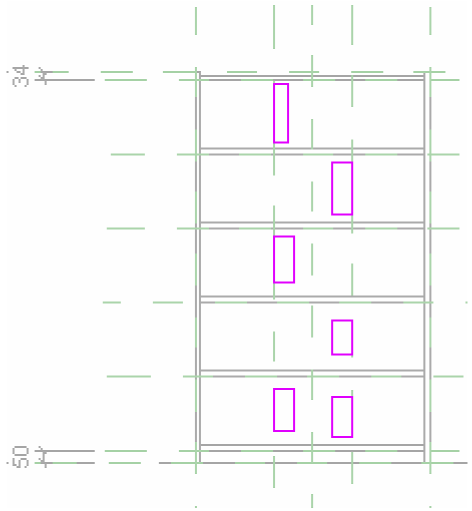
110. Click **Align** on the toolbar. On the Options Bar, select the **Multiple Alignments** options.

111. Click the left reference plane (see image) and align the three rectangle lines, as shown in image.

112. Lock each alignment as you make it.

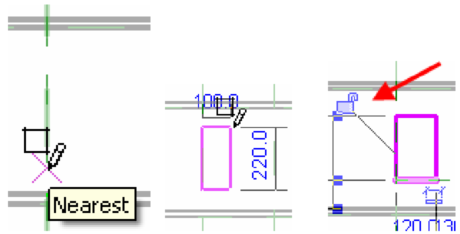


113. Repeat the process with the remaining rectangles and the right reference plane.



All these alignments are locked to maintain this constraint when you change the value of the width parameter of the furniture family.

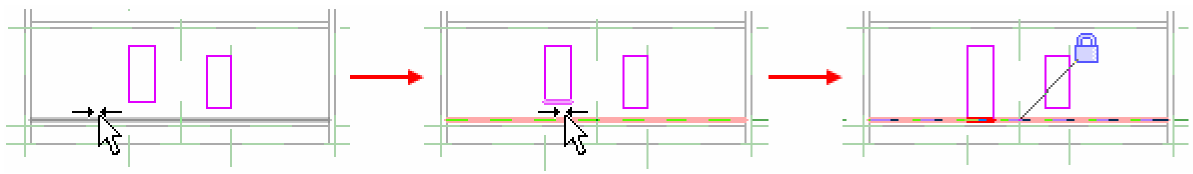
As you draw these rectangles, you can draw on top of the reference planes, and a lock appears. You can lock it at this time for the same effect.



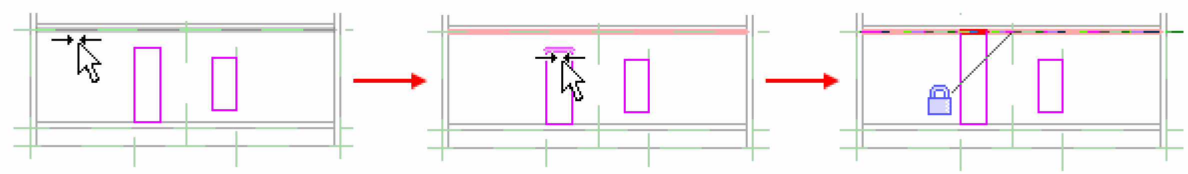
114. Click **Align**. On the Options Bar, clear the **Multiple Alignment** option.

115. Align the bottom line of the two bottom rectangles, as shown in image.

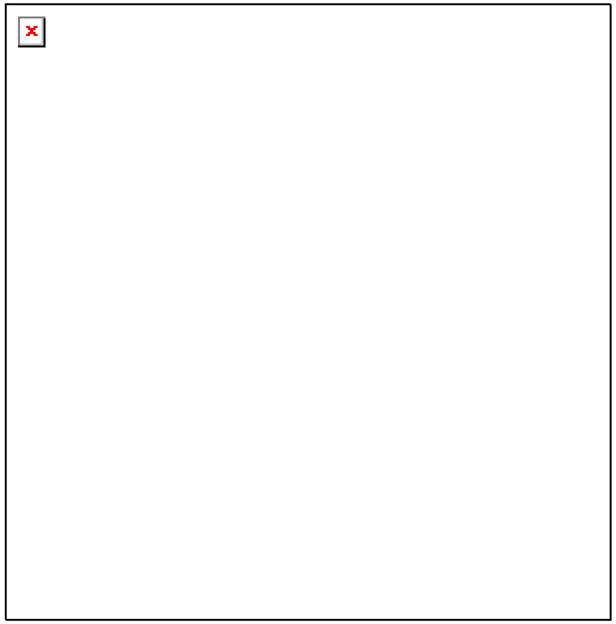
116. Lock the alignment.



117. Repeat the process with the top lines (see image).



118. Repeat the process for all the rectangles.

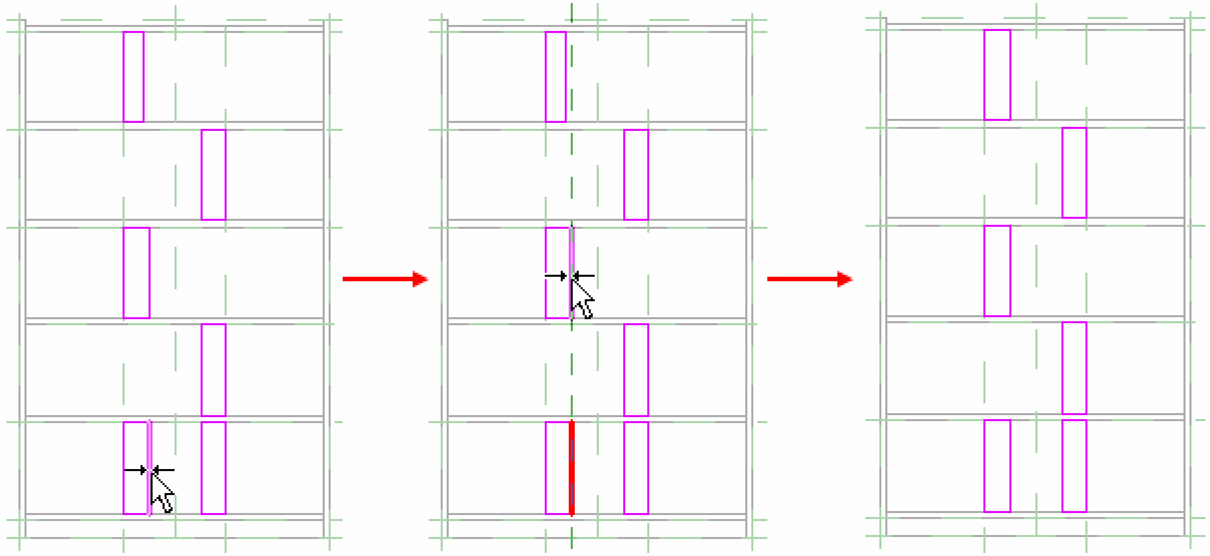


It is now necessary to manage the thickness of vertical separations. You operate in a way identical to the preceding stages, namely, a dimension locked between the reference plane and the unconstrained line of the rectangle. But before that, you align the sides of the rectangles between them (on the left and right).

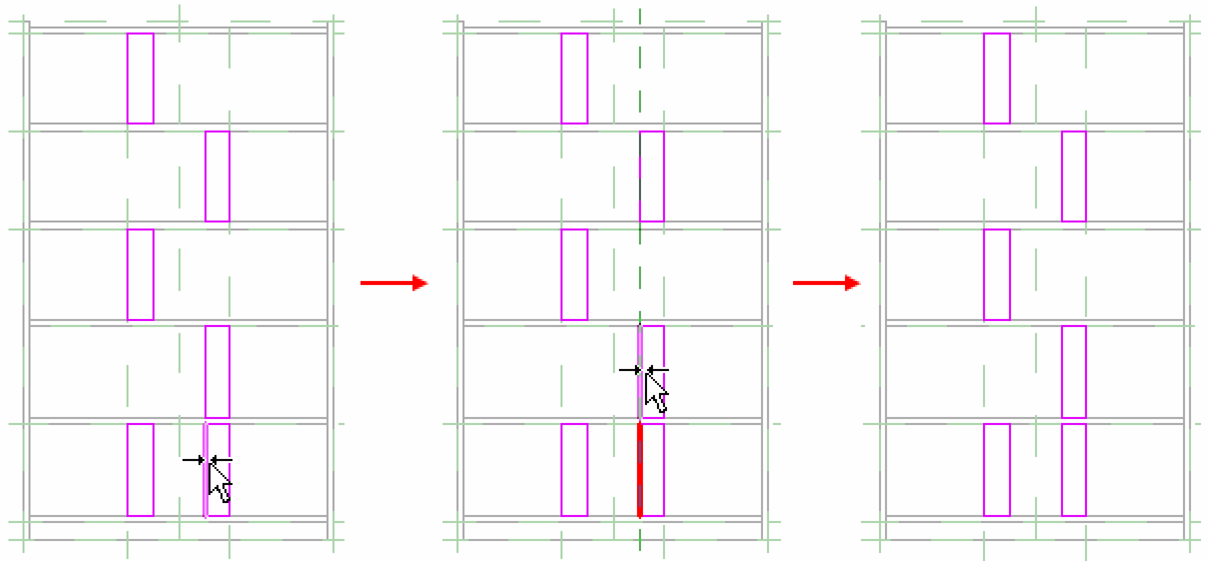
119. Click **Align** on the toolbar. On the Options Bar, select Multiple Alignment.

120. Click the right vertical line of the bottom left rectangle, and then click the right vertical lines of the rectangles on top of it (see image).

121. Lock each alignment as you make it.

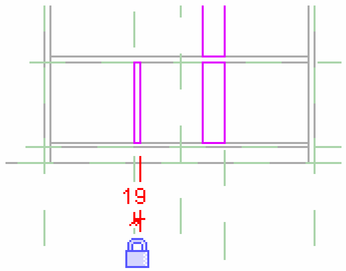


122. Repeat the process for the rectangles on the right side.



123. Place a dimension line between the vertical lines of the bottom left rectangle (see image).

124. Select the line, and in the dimension text change the value to **19mm**.

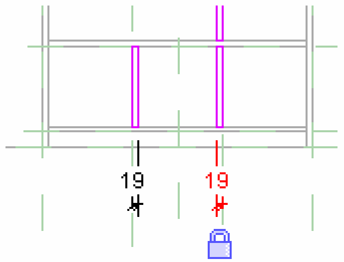


Because the right sides of this set of rectangles are locked together, you need to place only one dimension to control all rectangles in that set.

125. Select the dimension and lock it.

126. Repeat the process for the right rectangle.

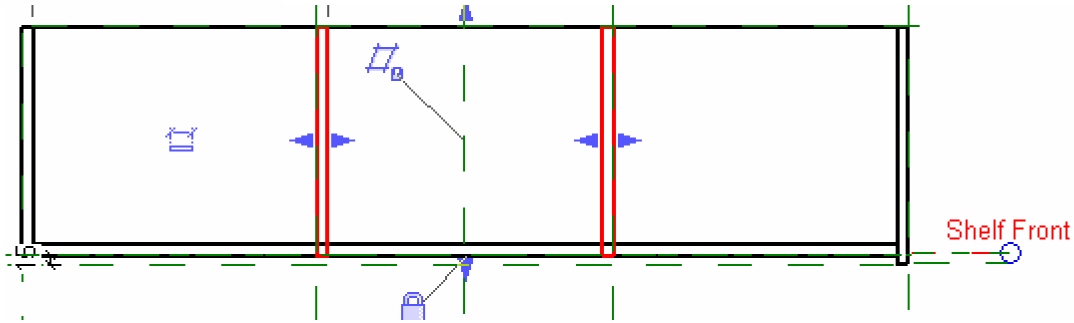
127. Click **Finish Sketch**.



128. Open **Ref. Level** view.

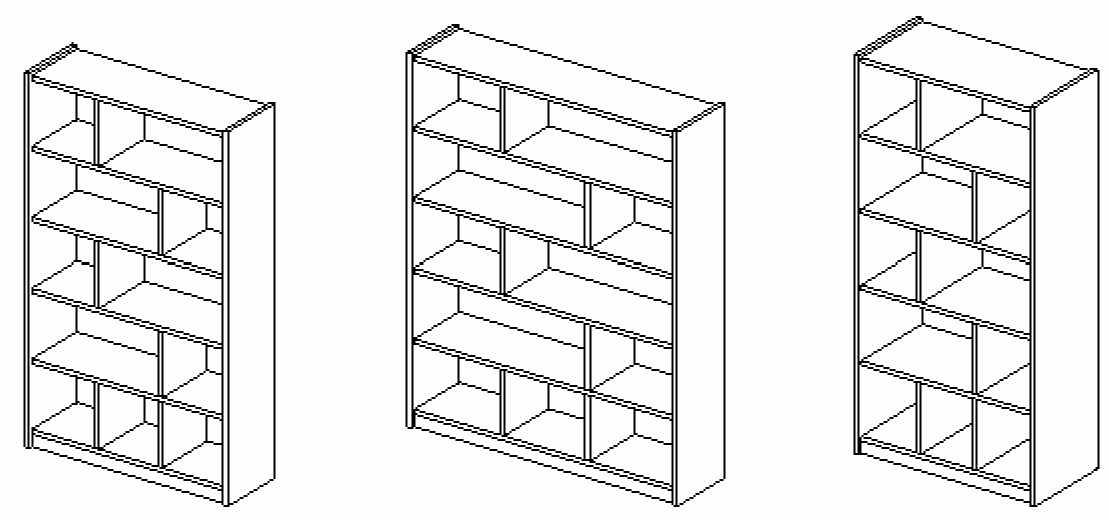
129. Select the 3D geometry, and use the blue grips to align the bottom face with the **Shelf Front** reference plane, as shown in image.

130. Lock the alignment.



131. Flex the model.

132. Save the family.

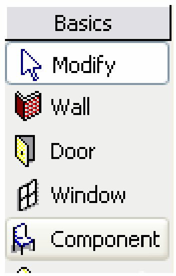


133. Start a new project to insert this family.

134. From the **File** menu, choose **Load from Library>Load Family**.

135. Navigate to where you saved the family and open it.

136. On the Design Bar (Basic) click the **Component** button. You can now place your family.



To test your new family in a project, you have to load it in a project. You can then insert it from the Component tool. Do not forget that your family is parametric! To find the parameters Width, Height, and Depth, open the type properties of the family.

Unit 11

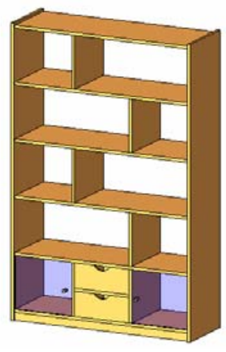
Theory: Propagation of Constraints

Autodesk Revit Building: Alignment, Locking, and Constraints

This unit is to be used with Lecture Units 10 and 11. Unit 11 builds on the family created in Unit 10. This unit has several exercises designed to illustrate various capabilities of the family within Autodesk Revit Building.

- Exercise A: Add the symbolic line representation to create the coarse, medium, and fine detail views. In addition, this exercise works with in-place family editing from the project environment.
- Exercise B: Add a material parameter to control the materials assigned to shelf unit.
- Exercise C: Add a glass door and assign a visibility parameter to control the display of the glass element.
- Exercise D: Work with nested families to add a drawer unit to the family, using the parent shelf parameters to drive the geometry of the nested family.
- Exercise E: Fine-tune the family, adding control of family elements through the use of subcategories.

In this unit, you complete the furniture family created in the previous unit by adding more components to it. See image.



The family that you created in the first part of the exercise requires more work so you can use it properly. You need to generate its 2D representation, associate all necessary materials, and define the levels of detail. Later in the exercise, you can experiment with nested families and formulas—an enormously powerful part of the Family Editor.

Unit 11, Exercise A: In-Place Family Editing and Symbolic Line Representation

When you create a family, you need to define how that family behaves in different views (plan, section, elevation, 3D). The first important decision is its 2D representations: will the display of the family in plan view simply result from a cut 3D view, or should it be represented with a simple 2D sketch? In this case, it is not generated from the 3D model, but is represented with a 2D sketch that you create. After you have defined the way your family (object) is displayed in different views, you need to define its representation in different scales (coarse, medium, fine) for all views. So, this is your objective:

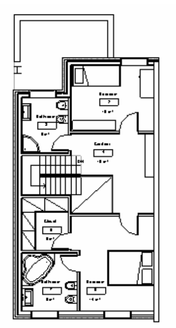
	Coarse	Medium	Fine
Plan View			
Section, Elevation, 3D View	Display representation is generated from the 3D model		

You need to add two new sketch drawings to your family—one for its Coarse-Medium representation and one for the Fine representation. You use the symbolic lines for these sketches. You set the visibility of the objects in the family such that only the sketch lines display in the project and not the 3D elements of the shelf.

Open a Project and Load the Shelf

1. Open **Unit 11a – Start.rvt**.

2. Verify that the view Floor Plans: Level 2 is current.



3. From the **File** menu, choose **Load from Library>Load Family** to launch the Browse dialog box.

4. Browse to the *Workbook data set* folder and open the *rfa* folder within it.

5. Select the **Shelf Unit 11a.rfa**.

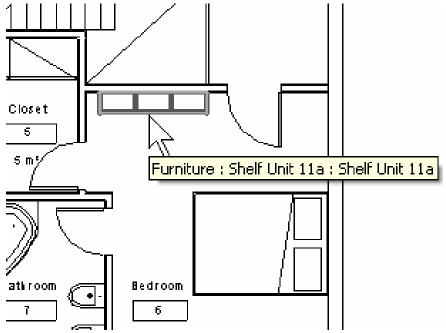
6. Click Open.

Place the Shelf Unit

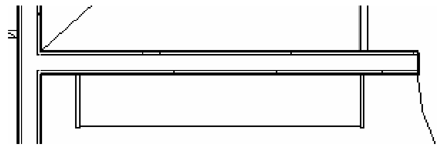
7. From the Basic menu, click the **Component** tool. .

The type should be set to Shelf Unit 11a. By default, the last loaded component is set when you use the Component tool.

8. Place an instance on the north wall of the master bedroom.



The shelf has no symbolic lines. What is displayed in the drawing window is the solid form elements cut at the cut plane of the view.

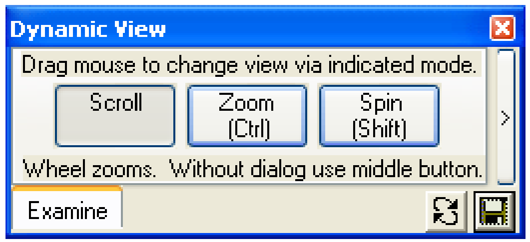


Create a Cropped 3D View

Create a 3D view that has an active section box. Use section boxes to slice away parts of the model to show the interiors.

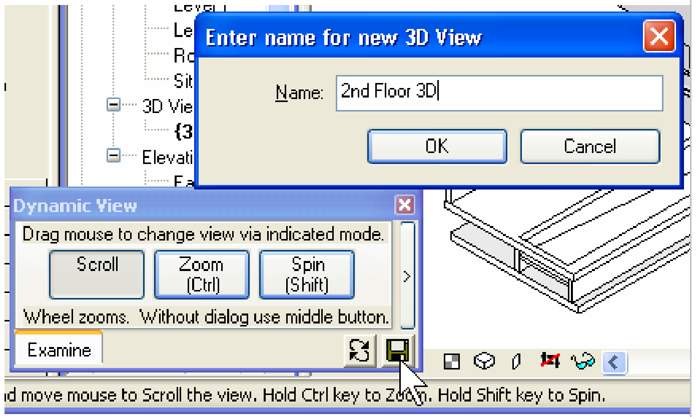
9. Set the **3D view** current.

10. Press the **F8** key to bring up the Dynamic View dialog box.



11. Click the disk icon in the Dynamic View dialog box.

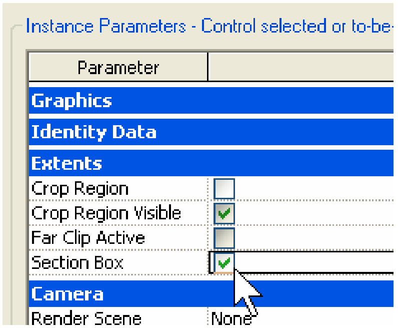
12. Enter **2nd Floor 3D** for the name.



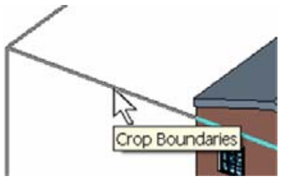
13. Click OK.

14. Right-click in the drawing window, and choose **View Properties**.

15. Select **Section Box** in the view properties and click OK.

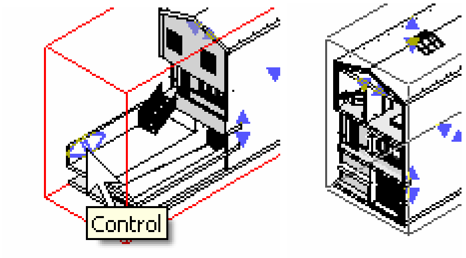


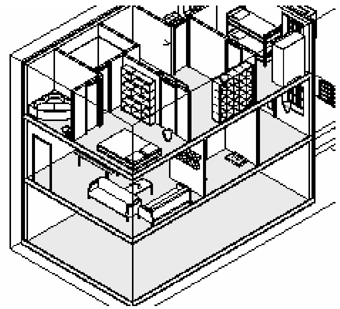
16. Select the section box that appears in the drawing window.



Turn on Shade mode if you want.

17. Use the face grips to cut away the roof, south walls, and east walls.



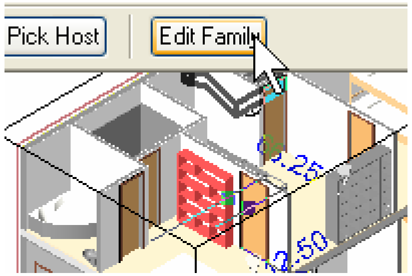


Edit the Shelf Family in Place

To facilitate the creation of the 2D sketch, you are going to duplicate the Ref Level view. Revit Building lets you associate different levels of detail to different views: one for Fine and another for Coarse/Medium.

You make only one view for both Coarse and Medium because the 2D geometry for these two representation is the same.

18. Select the shelf unit, and on the Options Bar click **Edit Family**.



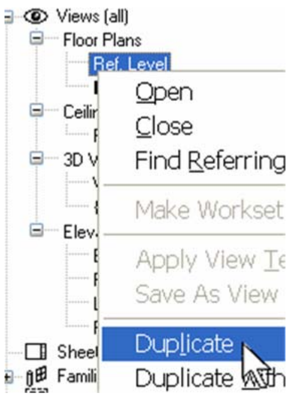
19. Click **Yes** to open the family for editing.

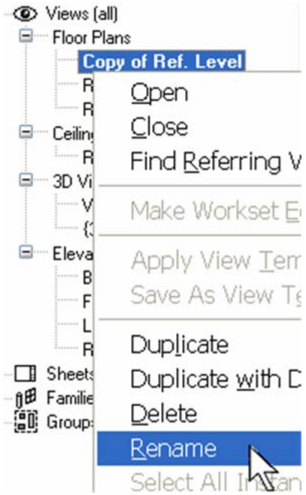
Set up Duplicate Views of the Ref. Level View

20. In the Project Browser under Floor Plans, activate the view **Ref. Level**.

21. Right-click **Ref. Level** and choose **Duplicate**.

22. Right-click the newly created **Copy of Ref. Level,** choose **Rename,** and change the name to **Ref. Level (Coarse - Medium)**. Click **OK**.



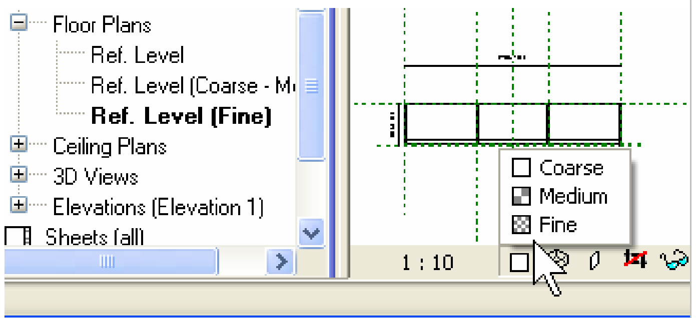


23. Repeat the operation and create a new duplicate named **Ref. Level (Fine).** When you click OK, Revit Building asks if you want to rename the corresponding view and level. Confirm with **OK**.

24. Set Ref. Level (Fine) current.

25. Use the drawing window view toolbar to set the Detail Level to Fine.

26. Using the same method, assure that **Ref. Level (Coarse - Medium)** has **Coarse** set as detail level in its properties.

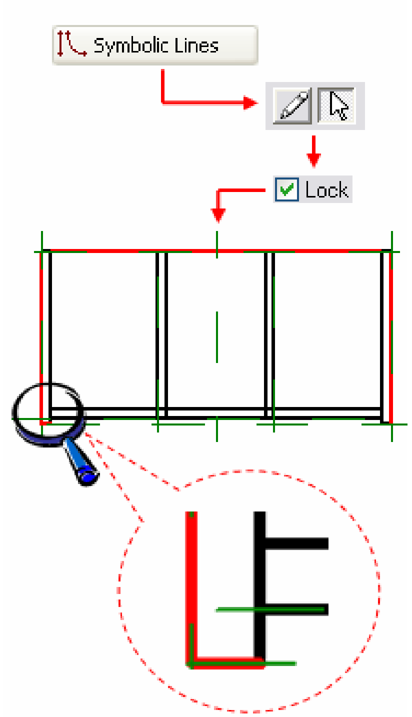


27. Make sure that **Ref. Level (Coarse - Medium)** is the active view (if not, double-click it).

28. On the Design Bar, click **Symbolic Lines**.

29. On the **Options Bar**:
    - Click the Arrow sign (**Select**).
    - Select the Lock item.

30. Select the four lines: bottom left, left, top, and right, by clicking them, as shown in the image.



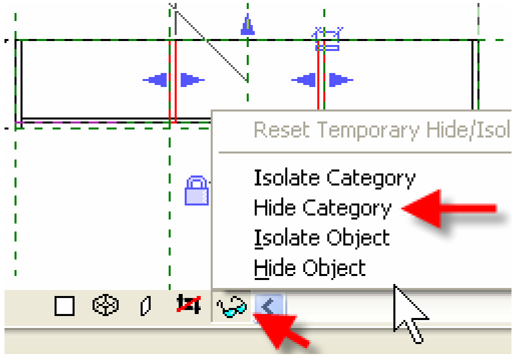
A check in the Lock box means that the selected lines automatically lock to the geometry from which they have been generated.

You need to trim the symbolic lines you have just created. But because there is a lot of overlapping geometry, this can be a tedious task. To simplify it, Autodesk Revit Building offers a temporary Hide/Isolate option to hide all 3D geometry, as well as the reference plane. You then have a pure 2D sketch drawing that is much easier to work with.

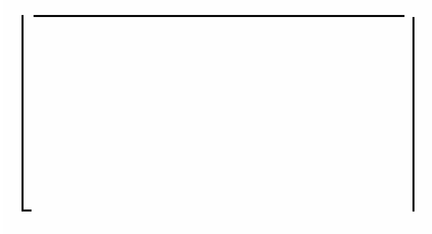
31. Click the **Modify** tool, and select the vertical separations as shown.

32. From the drawing window view toolbar, select the **Hide/Isolate** icon.

33. Choose **Hide Category** from the context-sensitive menu.

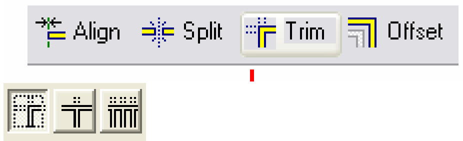


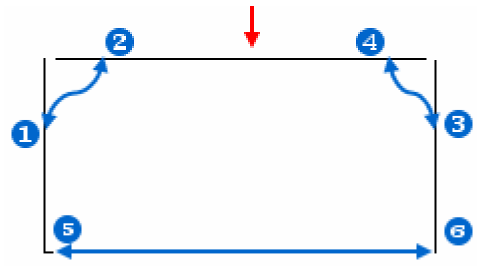
34. Select a reference plane and again click **Hide Category**.



35. On the **Tools** toolbar, click **Trim.** Verify that the Options Bar mode is set to **Trim/Extend to Corner**.

36. Trim the lines to close the rectangle.





You have just finished defining the 2D sketch for the Coarse – Medium level of detail. What remains is to tell Revit Building which lines should *not* be associated to the Fine level of detail.

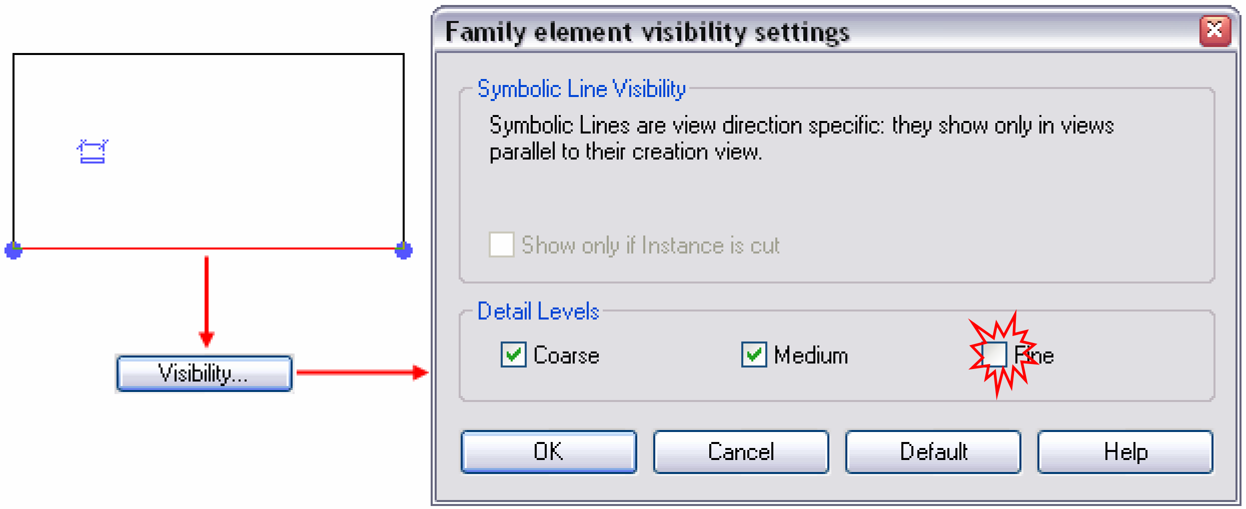
37. On the Design Bar, click **Modify** and then select the line that represents the front of the furniture.

38. On the **Options Bar**, click the **Visibility**

button.

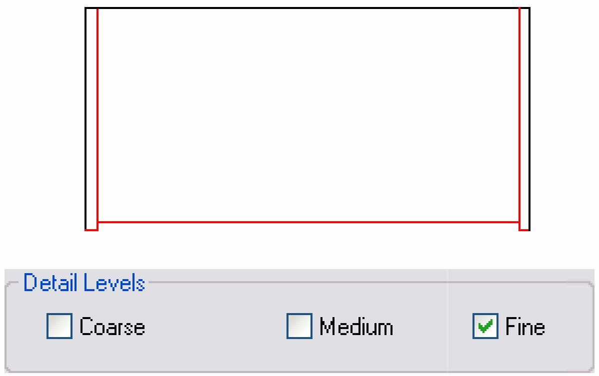
39. In the **Family Element Visibility Settings** dialog box, clear the Fine check box. Thus the selected line is invisible in views set to this level of detail.

40. Click OK to confirm.



41. Activate the **Ref. Level (Fine).**
42. Right-click in the drawing window and choose **Zoom Fit**.

43. Use the same methods to
    - Hide the Reference Plane category
    - Add five Symbolic lines as shown - Pick Lines – Lock
    - Hide the solid geometry category
    - Clean up the symbolic lines, as shown
    - Set the visibility of the newly created lines to Fine



Remember to use the Symbolic Lines Pick tool with the lock so the symbolic lines are related to the solid geometry. The solid geometry is driven by the family type parameters. If you just hide everything and draw the lines, they do not flex with the model.

44. Click OK.

Flex the Family

45. Tile the screen so you have both views next to each other.

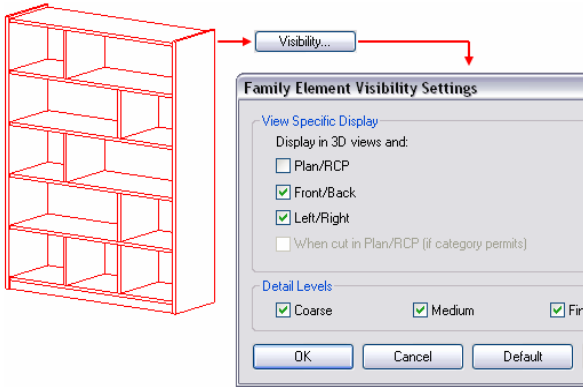
46. Try modifying the Width or Depth parameter. Note that the 2D geometry reflects the change and updates automatically.

Use Window>Close Hidden Windows before you use Window>Tile. This keeps all the windows you have open (which is often quite a few) from cluttering up the view. Leave the project that you started with open for the next step.

47. Activate the 3D view and select the entire geometry.

48. On the Options Bar, click the **Visibility** button and clear the **Plan/RCP** check box.

49. Click **OK**.



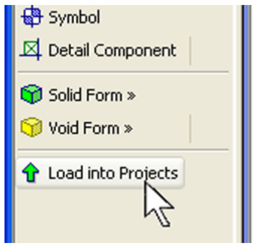
In Plan/RCP views you are going to use the 2D geometry you just created as representations for Plan/RCP. For all other ways, the representation is generated from the 3D model and in all levels of detail.

Reload the Family into the Project

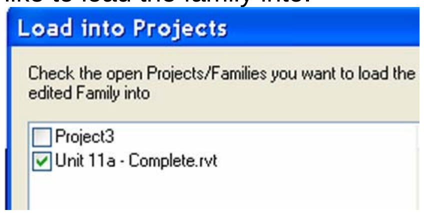
At this point you can either load the family back into the project or save the family out and overwrite the original RFA file. Or use the Save As command to create a new family based on these modifications.

Here, you load the family into the project.

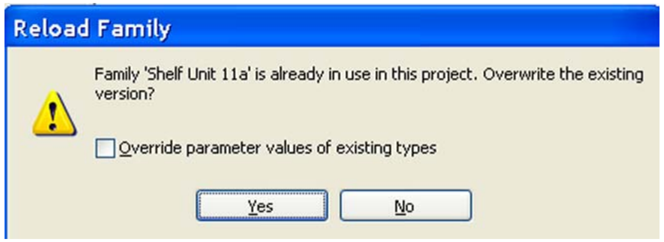
50. On the Design Bar, click **Load into Projects**.



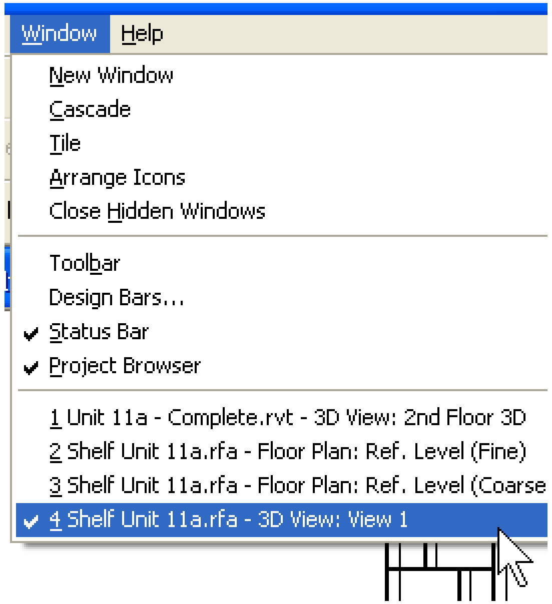
This step loads the family into any projects you have open. If you have more than one project open, you are prompted as to which you would like to load the family into.



51. Click **Yes** to overwrite the existing version.



52. Use the Window menu to change back to the shelf project.



53. From the File menu, choose **Close** to close the family file.

54. Do not save changes. They are already transferred to the project.

55. Save the project.

At this point your work has been transferred into the current project. You do not need to save the family you are working on, but you do need to save the project file.

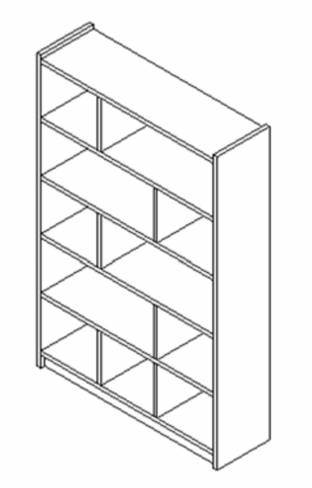
Unit 11, Exercise B: Material Parameters

In this exercise you add materials to the shelf.

Although you could assign material directly to the solid extrusions as part of their properties, this definition would be static, lacking the ability to control the materials in the project. Autodesk Revit Building provides a parameter type that enables you to apply materials once the object is in a project. This can be either a type or an instance parameter.

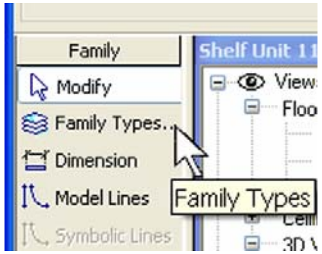
Create New Material Parameters

1. Open Workbook data sets\ **Unit 11b Shelf - Start.rfa.**

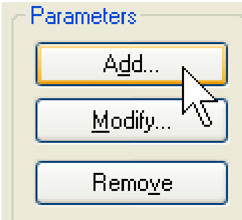


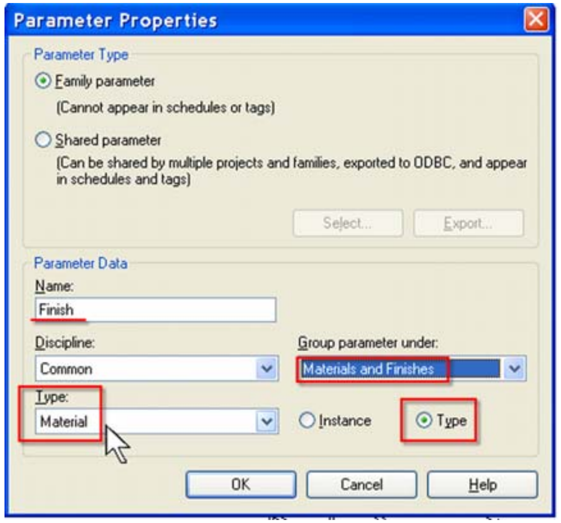
This is a family file in the same folder as the other exercise data files, though it is a family RFA file rather than a project RVT file.

2. On the Design Bar, click **Family Types**.



3. Click Parameters **Add**.
   In the **Parameter Properties** dialog box set the following:
   - Name = Finish
   - Groups Parameter Under = Materials and Finishes
   - Type = Material
   - Type button
4. Click **OK**.





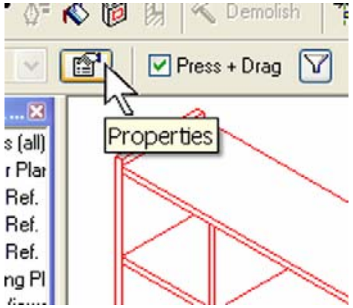
For the moment, your family is fully parametric in respect to its dimensions, but you will add a new type of parameter that allows the user to parametrically change the material associated with the furniture as well. For now, you create just one material parameter to apply to the entire 3D geometry.

5. View the new parameter in the Family Types dialog box.
6. Click **OK** to return to the drawing window.

The Finish Parameter is now part of the family definition. At this point it is not assigned to any particular element.

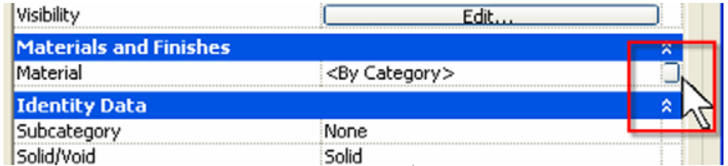
If you did not make the Finish Parameter, then you would not have access to this control once the family was in a project. Only those parameters appearing in the Family Types dialog box are available for editing in a project. You need to assign this parameter to the solid extrusions.

7. Select all 3D geometry and click **Properties**.



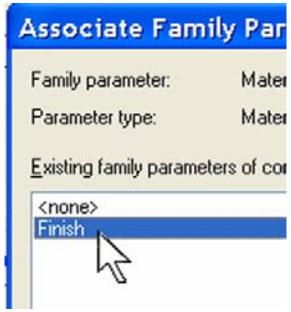
The material parameter is a hard-coded property of a solid extrusion. You need to assign the *family* parameter **Finish** you just created to this property. Assign a family parameter to an element property to control the element from within a project.

8. In the **Element** properties, click the button to the right of **Material**.



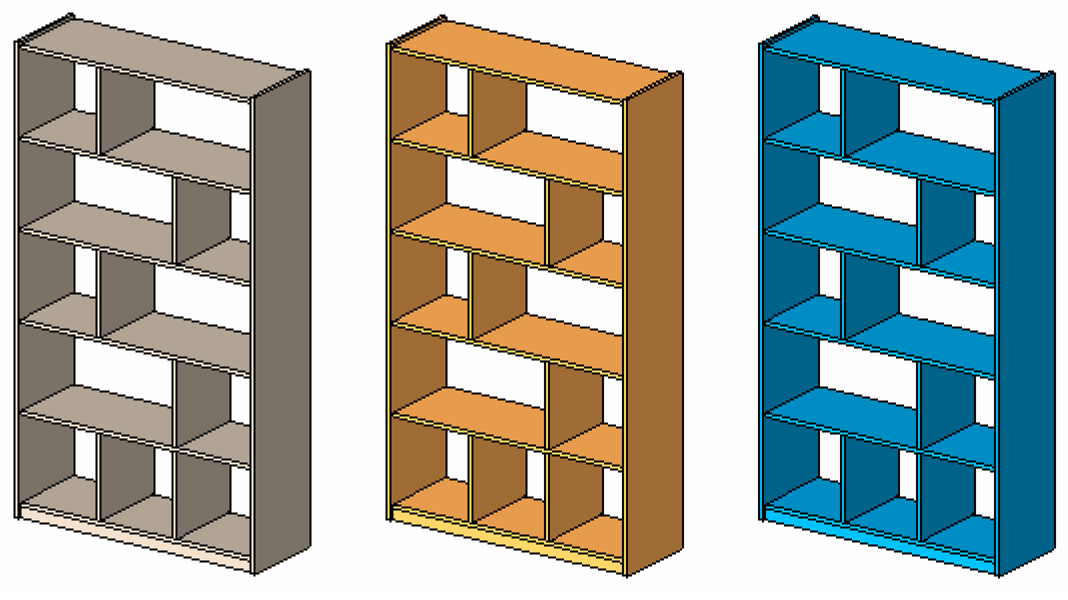
9. In the **Associate Family Parameters** dialog box, click the **Finish** parameter.

10. Click **OK** in all open dialog boxes.



If you want, you could create a new material within the Family Editor and associate it as the default material for the family. All materials created in the family are going to be automatically created in every project where this family is loaded. If an existing material has the same name, the family material is overwritten. That is why it is advisable to give your materials specific names.

11. From the **File** menu, choose **Save**.
12. Close the family.
13. Start a new project and load your family. Insert a few instances of this family in the project and try changing their parameters. Note that all modifications are propagated in all instances of this family. This is because you have defined all family parameters as **Type** parameters.



Unit 11, Exercise C: Visibility Parameters

In this exercise you add glass doors to the shelf unit. You have now worked with two types of parameters.

Parameter Type	Name	Assigned to	Contols
Length	Width, Depth, Height	Dimension	Geometry
Material	Finish	Solid Extrusion properties	Material assigned to the solid

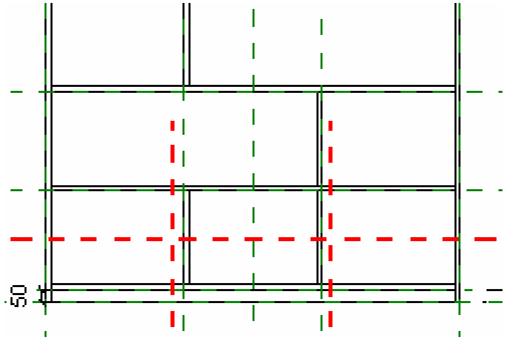
In this exercise you create two glass doors for the shelf unit. You create a new parameter in the family that is a Yes/No parameter type. Yes/No parameters have several uses. In this exercise you assign the Yes/No parameter to the visiblity of the glass doors. This enables you to turn them off in a project if you do not want to see them. They are still defined in the family, but not visibly.

This exercise continues from the last exercise. If you worked through Exercise 11B, and were successful in both applying materials and manipulating the dimensions parameters, you can continue working on your family in this exercise.

In this exercise you add and constrain new references as well as create solid extrusions and voids. Go back to Unit 10 if you need to review these tasks.

Create Reference Planes for the Door Pulls

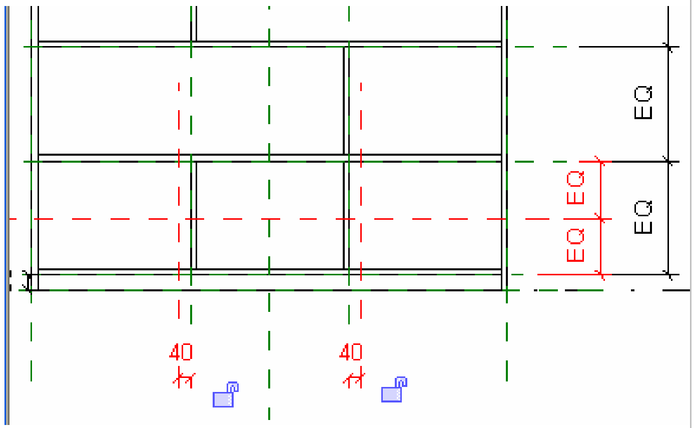
1. Open Workbook data sets\ **Unit 11c Shelf - Start.rfa**.
2. Activate the **front** view.
3. Add the three new reference planes shown in the illustration.



Families recognize logical conditions like Yes/No. You use that to control the visibility of the glass doors within the shelf unit. The next task is to create the geometry of the glass doors.

These reference planes are used to locate the glass door handles later in the exercise.

4. Add the constraining dimensions shown in the illustration.



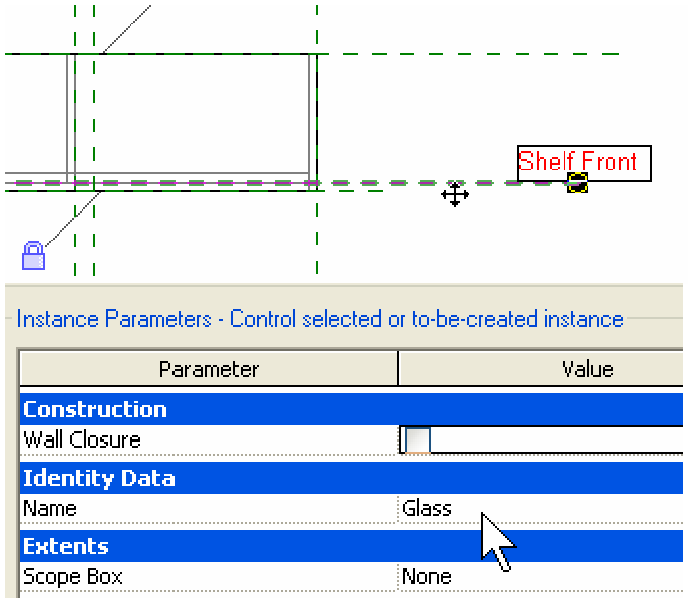
5. Activate the view **Ref. Level (Fine)**.
6. If the view shows a red background to the Hide/Isolate tool, click the Hide/Isolate button and then click **Reset Temporary Hide/Isolate**.
7. Click **Reset** to see everything.

To facilitate the creation of the glass doors, name one of the reference planes. The effect is to create a work plane on which you can trace your sketch of the doors. Just imagine you are inserting a sheet of paper on which you are simply drawing a sketch.

8. Activate the **Ref. Level**.

9. Select the horizontal reference plane that is second from the bottom, and on the **Options Bar**, click the **Properties** button.

10. In the Properties dialog box, change the name to **Glass** and click **OK**.



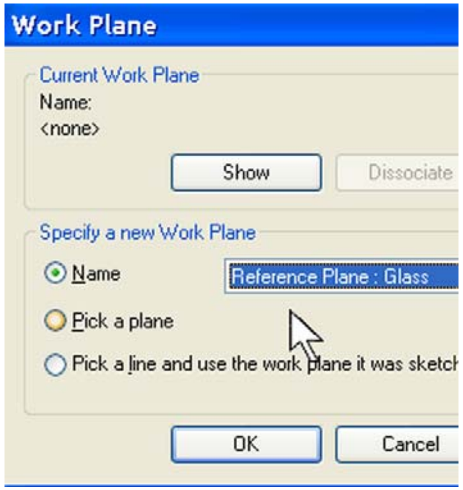
11. Activate the **front** view.

12. On the Design Bar, click **Solid Form>Solid Extrusion**.

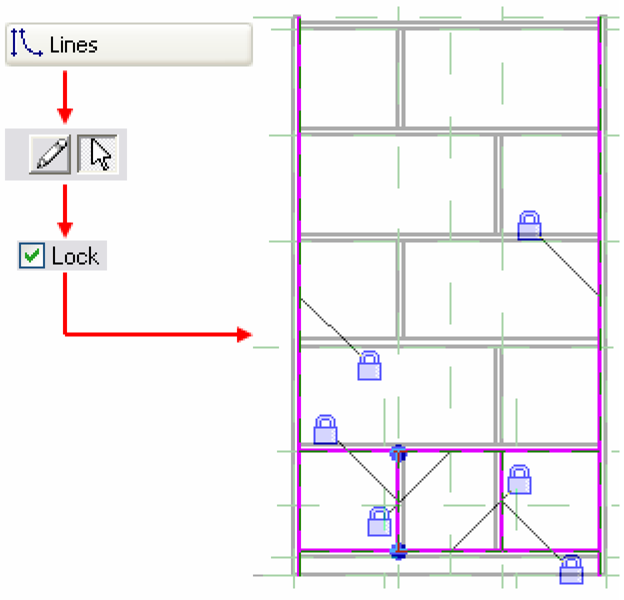
13. On the Design Bar, click **Set Work Plane**.

14. In the **Work Plane** dialog box, select **Glass** from the **Name** list.

15. Click **OK**.

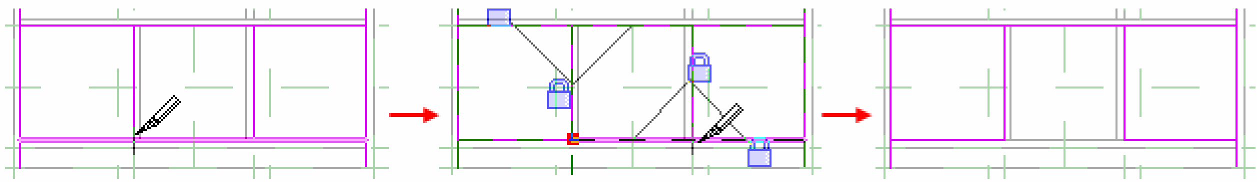


16. On the Design Bar, click **Lines**.
17. On the **Options Bar,** click **Select** and select the **Lock** check box.
18. Click the lines that form the first shelf, as shown.

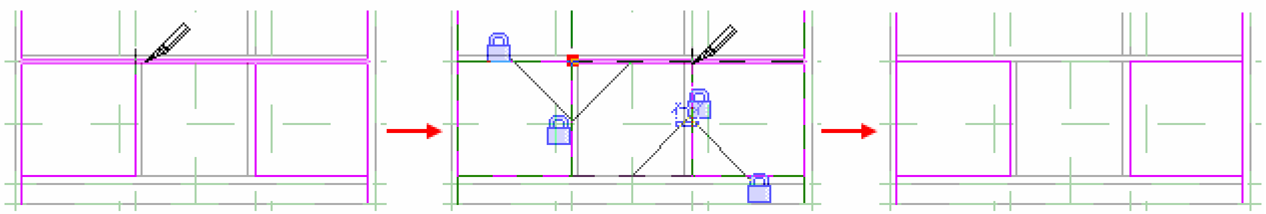


For a sketch to be valid for an extrusion, it should not have T intersections and its line must be in a closed loop. Since this is not the case for your sketch, you need to fix it.

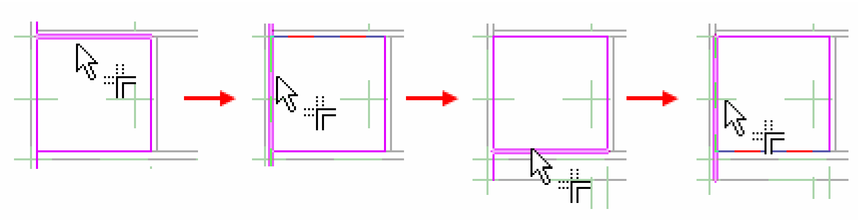
19. On the **Tools** toolbar, click the **Split** tool.
20. On the **Options Bar**, click **Delete Inner Segment** and select the two middle vertical lines as well as the bottom one.



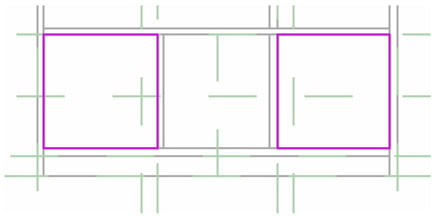
21. Repeat for the line above.



22. Click **Trim**.
23. Set the trim mode to **Trim /Extend to Corner**.



24. Repeat for the other side.



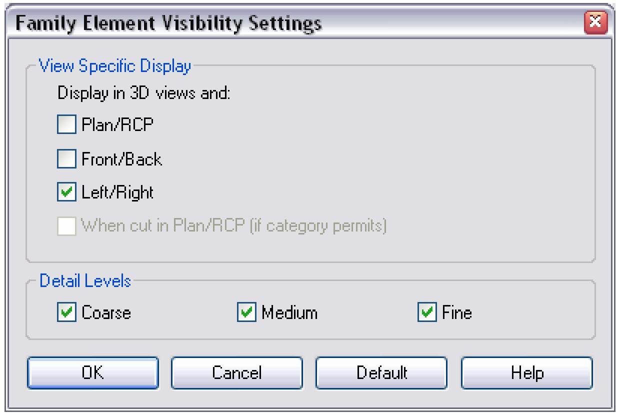
25. On the Design Bar, click **Extrusion Properties**.
26. Set **-8mm** for the **Extrusion End** (this means that the glass starts on the interior side of the furniture).

The value positive or negative when drawing an extrusion from a reference plane depends on the direction you first drew the reference plane (right to left or left to right).

If you get it wrong here, you can always change it after you are finished with the sketch, by looking at the extrusion properties.

27. Click the **Edit** button next to **Visibility**.

28. Clear the **Plan/RCP** check box, as well as **Front/Back** (this means that these doors are not displayed in the plan or elevation view).
29. Click **OK** to return to the Element Properties dialog box.

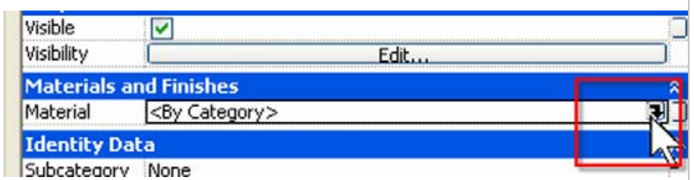


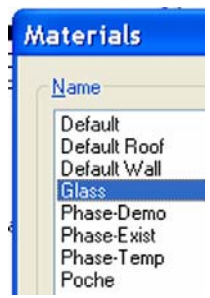
30. Click the button next to Material and select **Glass**. Click **OK**.

31. Click OK again to close the Element Properties dialog box.

32. On the Design Bar, click **Finish Sketch**.

33. **Save** the file (File>Save).





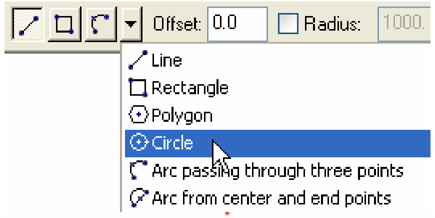
Create Pulls for the Glass Doors

When you assign a material in this way, the material is static. You cannot assign a different material to the element placed in a project.

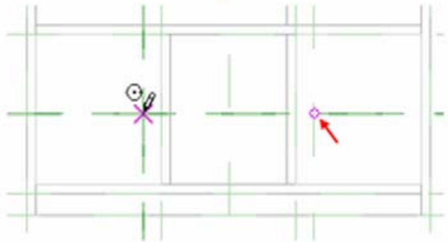
34. Select **Solid Form>Solid Extrusion**.

35. On the Design Bar, click **Set Work Plane**. In the dialog box make sure that the active work plane is set to **Glass**.

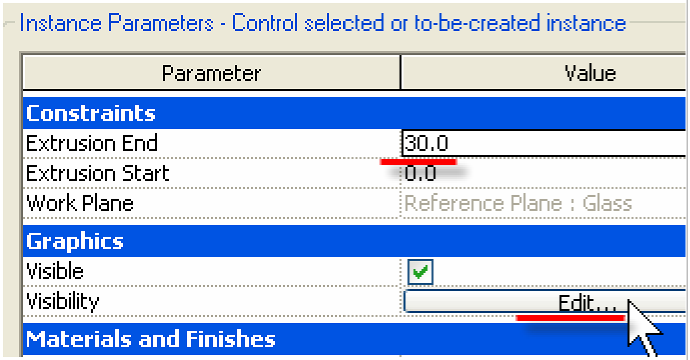
36. Select **Lines**, and on the **Options Bar**, click the circular shape. Activate the **Radius** and set it to **10mm**.



37. Add two circles, as shown on the right. Note that the center of insertion is the intersection point of the reference planes.



38. On the Design Bar, click **Extrusion Properties** and set **30mm** as an extrusion end.

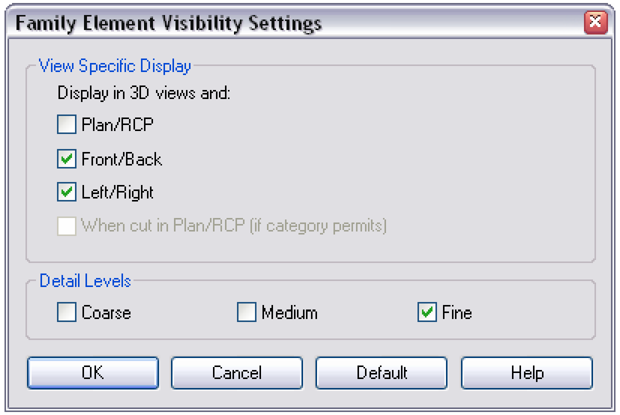


39. Click the **Edit** button next to **Visibility** and clear **Plan/RCP**. For **Detail Levels**, set only the **Fine** one to be active. (This means that knobs are visible only in a Fine level of detail).

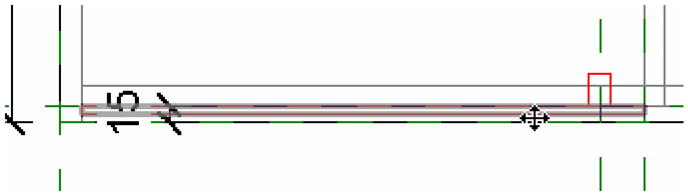
40. Click **OK** to close all open dialog boxes.

41. On the Design Bar, click **Finish Sketch**. Thus you are exiting sketch mode, and you have

finished creating the 3D object.

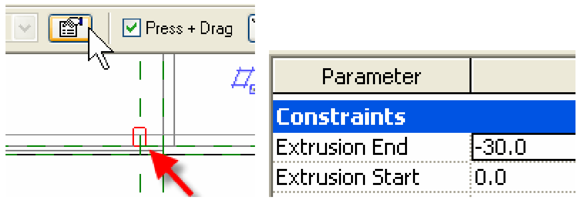


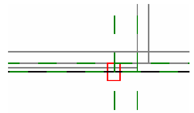
42. Set current Floor Plans: Ref Level.



Assumptions about the start and end of the extrusions were opposite because the reference plane was drawn from left to right. A negative value extrudes toward the viewer, and a positive value extrudes away.

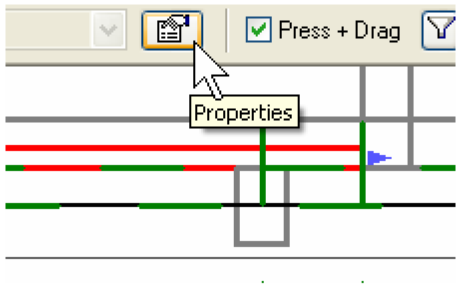
43. Select pulls.
44. On the Options Bar, click **Properties**.
45. Set Depth = **-30mm** (negative).
46. Click **OK**.

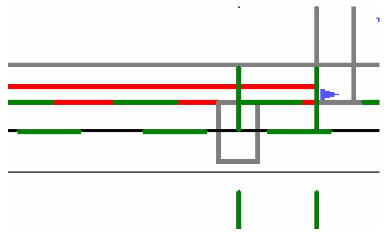




The door pulls are reversed.

47. Select glass door.
48. On the Options Bar, click **Properties**.
49. **Set Depth = 8mm (positive).**
50. Click **OK**.

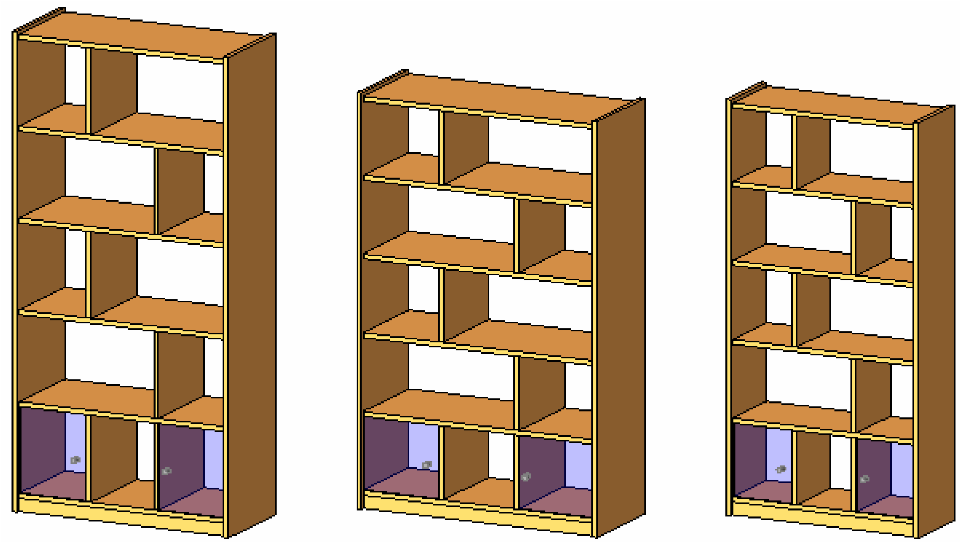




You have access to this information from the Extrusion Properties on the Design Bar as you sketch the extrusion or after you finish the sketch from the object properties.

51. From the **File** menu, choose **Save** (make it a habit to save your work often).

52. Flex your family to test it.



Create a Display Control Yes/No Parameter

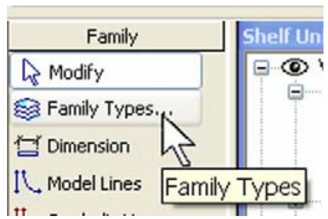
53. On the Design Bar, click **Family Types**.

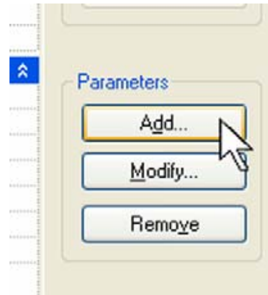
54. In the dialog box, under Parameters click **Add.**

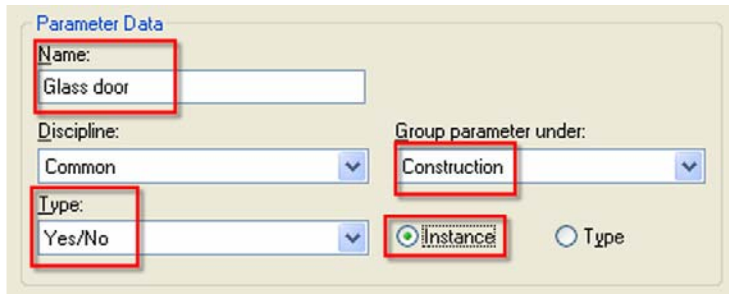
55. In the **Parameter Properties** dialog box set the following:

- Under Name, enter Glass Door.
- Group Parameter Under: Construction.
- Under Type, select Yes/No.
- Select Instance (parameter can vary from one piece of furniture to another).

56. Click **OK** to return to the Family Types dialog box.

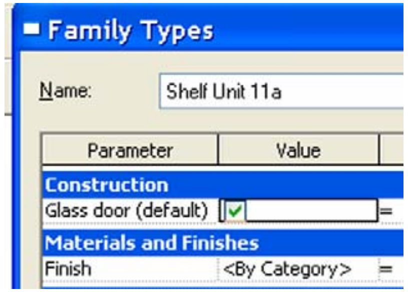






57. Verify the parameter.

58. Click OK to return to the drawing window.



The glass door parameter appears, ready to be assigned to the visibility of an element.

A checked box means show, and a cleared box means hide.

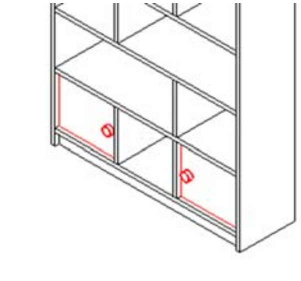
59. Select the glass doors and doorknobs, and click **Properties.**

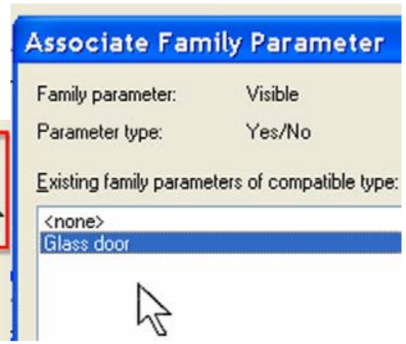
60. In the **Element Properties** dialog box, click the gray button at the right end of the **Visible** line. This button enables you to link one parameter to one property.

61. In the **Associate Family Parameter** dialog box, select **Glass Door.**

62. Click **OK** twice.

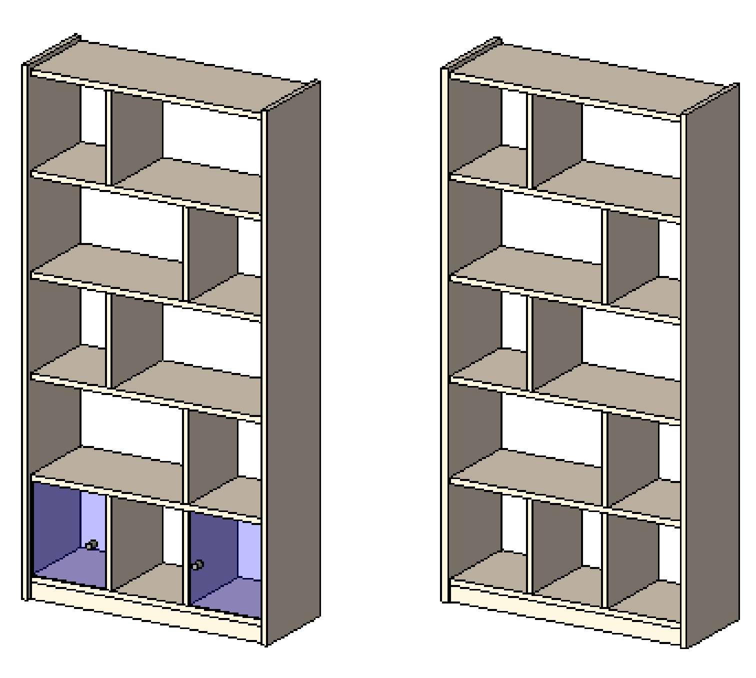
63. To verify functioning of this parameter, load the family in a project.





64. Save your work again.

65. Start a new project, load your family, insert a few instances of the family in the project, and try modifying the parameters. The new, added parameter lets you control visibility of the glass doors and the doorknobs per instance. Try changing to different levels of detail in 3D view. The doors and knobs should display only in a Fine level of detail. Try also changing the level of detail in plan view. There, regardless of the level of detail, the doors and knobs should *not* display.



Unit 11, Exercise D: Nested Families

In this exercise you add drawers to the shelf unit. To create the drawers you first create a new furniture family and build a single drawer in it. You load this drawer family into the shelf unit family, “nesting” the drawer family in the shelf unit file.

To finalize your family, you add two drawers in the opening between the glass doors. Instead of modeling it in the shelf unit family, you create a new family for the drawer and then insert it in this one as a nested family. The width of this interior space is determined by the overall width of the family type—or the width parameter. You create formula-type parameters that are based on the depth, width, and height parameters of the shelves and pass these parameters through to the nested drawer family. However, first things first: let’s create the drawer family.

Note that the description for creating the drawer is less detailed than the previous one. If necessary, refer to the inital creation of the shelf unit to review the processes. Roughly, this exercise breaks down into the following sections:

- Create a drawer family: This is a new family you create.
- Create a drawer shelf: This takes place in the shelf unit family and is a review of the Unit 10 exercise.
- Create drawer parameters in shelf unit family. These drive the geometry of the nested drawer family.
- Create formulas for the drawer parameters within the shelf unit family. The formulas perfom arithmetic operations on other family parameters.
- Load, place, and position a drawer. You can load other families to use inside families as components.
- Link parameters from the shelf unit family to the drawer family.

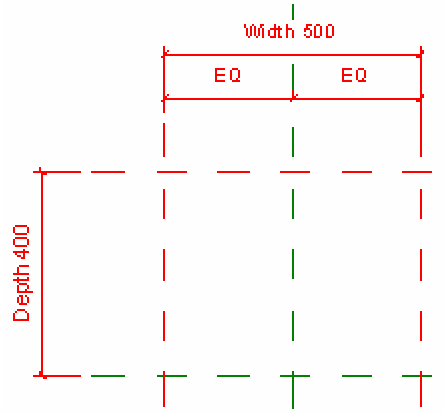
Create a Drawer Family

1. From the **File** menu, choose **New** and select **Family**. Select the **Metric Furniture.rft** family template and click **Open.**

2. Activate the **Ref. Level** view (Project Browser, Floor Plans).

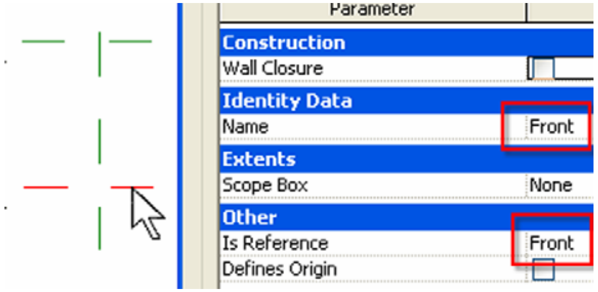
3. Add three reference planes, as shown.

4. Add dimensions, as shown.

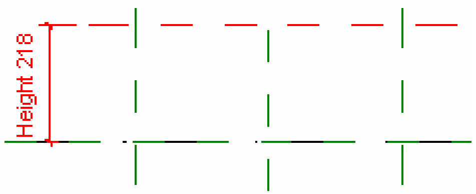


5. Set the dimensions to labels (parameters), as shown. (You need to create two new parameters: Width and Depth).
   - Group = **Dimensions**
   - **Type** parameter

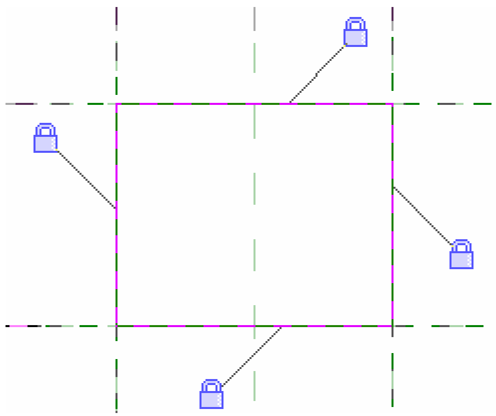
6. Select the horizontal reference plane and in its properties select:
   - Name = **Front**
   - Is Reference = **Front**



7. Activate the front view and add another reference plane above the existing one. Create a new parameter **Height**.
   - Group = **Dimensions**
   - **Type** parameter



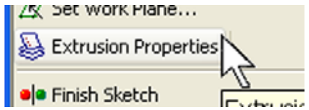
8. Activate the **Ref. Level** view. Add a **solid form** using the **extrusion** method. The sketch of the solid should be a rectangle with sides locked to the reference planes. At this stage do *not* click Finish Sketch.



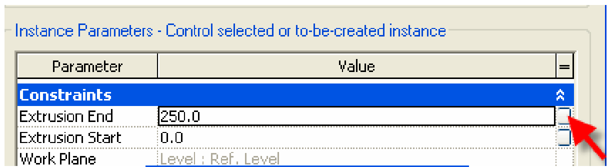
Note on drawing lines with the (rectangle tool) over reference planes: As you hold the cursor over an intersection of two reference planes, notice that one or both of the reference planes are highlighted.

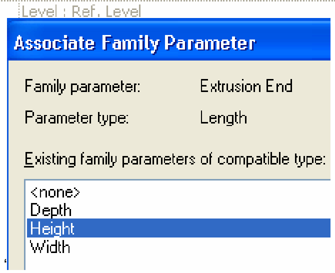
If only one reference plane is highlighted, move the cursor slightly until both reference planes are highlighted. Then click the intersection. If you do this with both corners of the rectangle, the locks automatically appear as shown.

9. Click **Extrusion Properties**.



10. In the dialog box, click the gray rectangle on the **Extrusion End** line.
11. Select the **Height** parameter.
12. Click **OK** to close the dialog boxes.



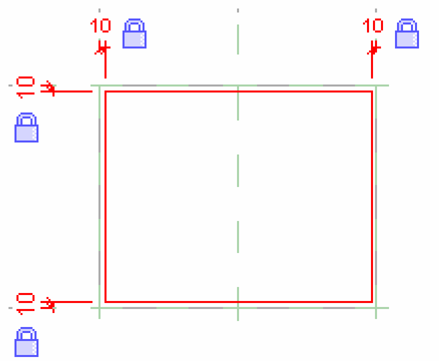


The Extrusion End (depth) is now dimmed because it is being driven by the height parameter. There is an equal (=) symbol here to let you know this has been assigned to a different parameter.

13. Click the **Finish Sketch** button.

14. On the Design Bar**,** this time click **Void Form>Void Extrusion**.

15. Draw a rectangle on the interior side of the existing solid. Using the **Dimension** tool, lock the edges of the void to the reference planes (fix the distance to **10mm**). At this stage do *not* click Finish Sketch.

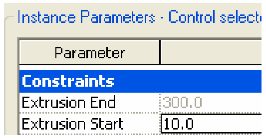


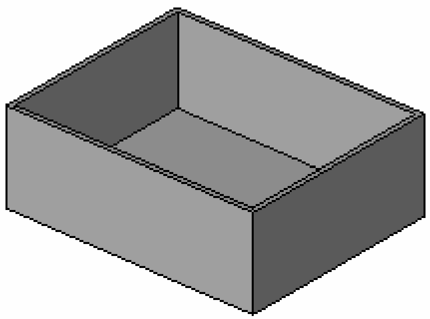
It is a good practice to dimension to the reference plane rather than the geometry of the previous solid form.

16. Just as in the previous case, in the **Extrusion Properties** dialog box, associate the **Extrusion End** to the **height** parameter and set the **Extrusion Start** to **10mm**.

17. This is the thickness of the bottom of your drawer. You can see this better in the front view.

18. Finish the sketch.

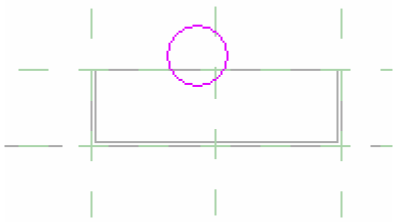




19. Activate the **front** view.

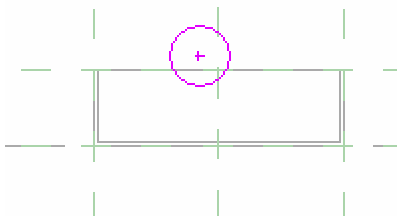
20. On the Design Bar, click **Void Form>Void Extrusion**.

21. Add a new sketch. This time it is a circle cutting out the opening spot for the drawer. Draw the circle as shown on the right. *Don't* click Finish Sketch as yet.



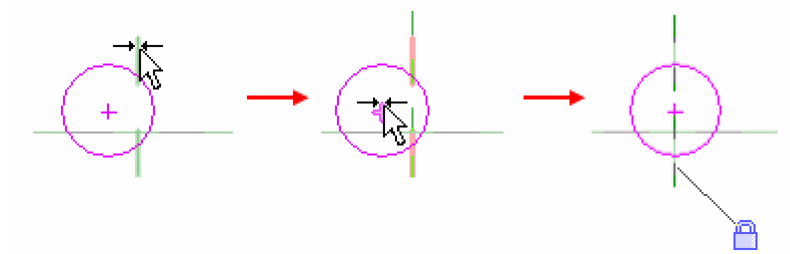
You need to assure that this sketch remains always aligned to the axis of the drawer width and that its position doesn't change in vertical sense either. To facilitate the aligning of a circle, activate the Center Mark Visible option and use it as a reference point for constraining.

22. Right-click the circle, and choose **Center Mark Visible**. Confirm with **OK**.

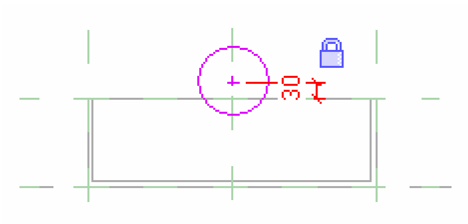


Note the cross in the middle of the circle. It is from this point that you define the constraints to the reference planes.

23. Using the **Align** tool, align and lock the circle to the central reference plane.

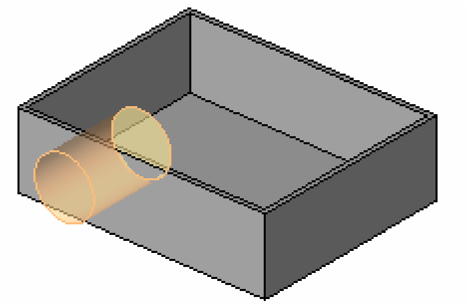


24. Add a dimension between the reference plane that defines the height of the drawer and the center of the circle. Set the distance to **30mm** and lock it.



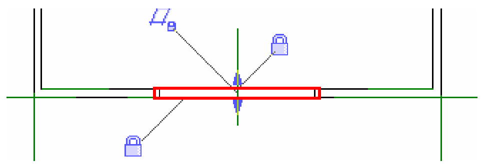
25. In the **Extrusion Properties** dialog box, set the **Extrusion Start** to **0**.

26. Click **OK,** and then click **Finish Sketch**.



The extrusion is heading the wrong direction. You need to fix that problem.

27. Open the **Ref. Level** view and select the void. Select the lower blue point and start sliding it toward the interior of the drawer. Lock that position.



28. Finally, add a new **Material** parameter**.** Name it **Finish** and associate the entire 3D geometry to it.

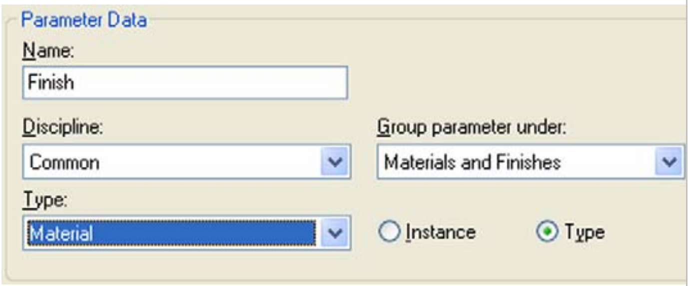
29. Flex the model to test your work. Try out different values for width, height, depth, and so forth.

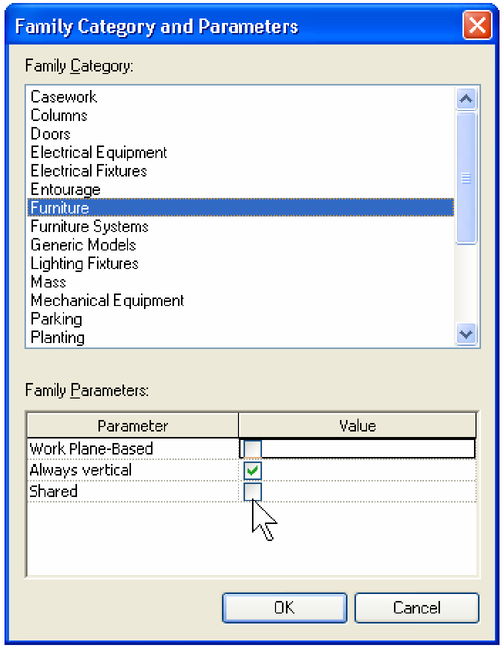
30. From the **File** menu, choose **Save As** and save the family as **Drawer.rfa**. Close this file.

Note that a nested family can also be a shared family. Make a shared family by choosing Family Categories and Parameters from the Settings menu.

The drawer family is now ready to be inserted in the furniture family, but you need to make a few adjustments.

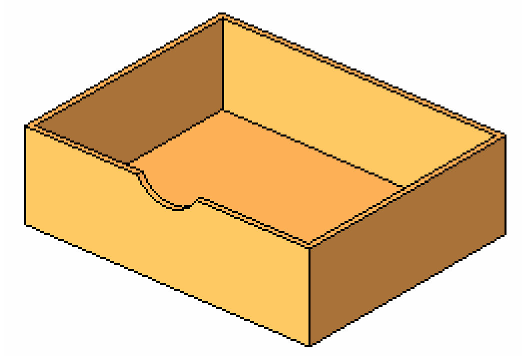
- You are missing a small shelf that is positioned between the two drawers when placed in the opening.
- There are no parameters in the big family that define the width, depth, and height of the drawer.





The first problem can be resolved using the same techniques used to create the shelf unit as well as the drawer.

The second problem requires formulas to help calculate the values of the drawer parameters. You create three new parameters:



By selecting the Shared check box, you change the behavior of the nested family when it is loaded into a project. When a nested family is shared

- You can load the family directly into a project to update all families that have that nested family
- You can schedule the nested family even though it resides inside a different family

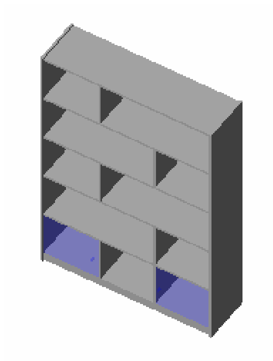
Drawer Width = (total width / 3) – (2 x thickness of the separation panel)

Drawer Height = ((((total height – 84mm) / 5) / 2) – 1 x shelf thickness)

Drawer Depth = total depth -15

Create Drawer Shelf in the Shelf Unit Family

31. Open workbook **Data set\Unit 11d Shelf - Start.rfa**.



The Unit 11d Shelf -Start.rfa is the end product of Exercise 11c. Use this as a starting point, or continue with a shelf unit you have tested in a project.

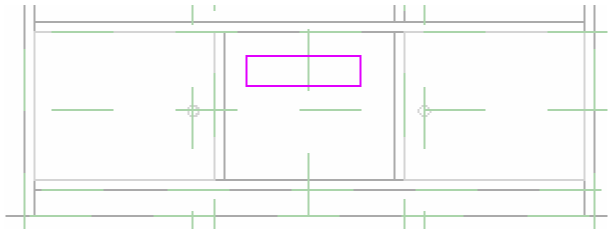
Now add the separation shelf between the two drawers. We won't explain in detail, because by now you have already learned how to do that. To review, see Unit 10.

32. Activate the **front** view.

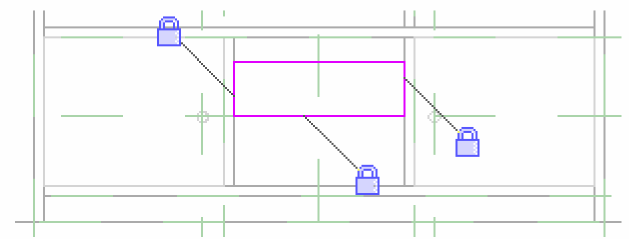
33. On the Design Bar, click **Solid** and click **Extrusion**.

34. Double-check that the active work plane is set to **Back**.

35. Add a rectangular sketch in the upper part of the empty middle shelf, as shown in the drawing on the right.



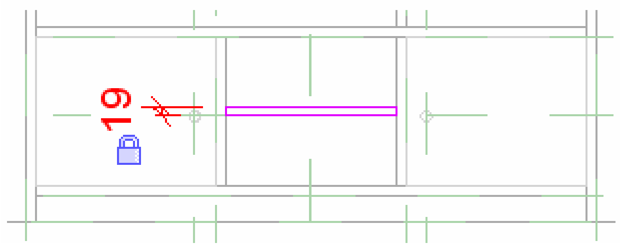
36. Align the sketch and lock, as shown.



37. Add a dimension for the shelf thickness.

38. Select the dimension chain, set it to **19mm** and confirm.

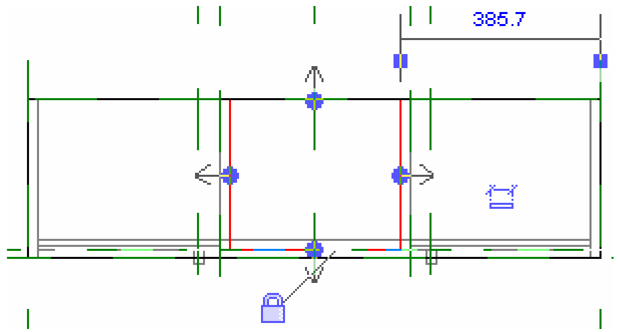
39. Lock this dimension.



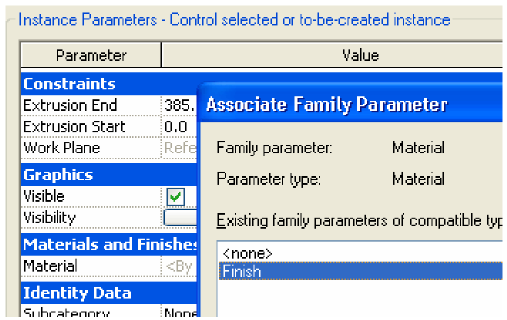
40. Click **Finish Sketch**.

41. Open the **Ref. Level (Coarse – Medium)**, select the 3D geometry, and using the blue point in the front, align it to the second reference plane from the bottom (see image).

42. Lock it to that position.



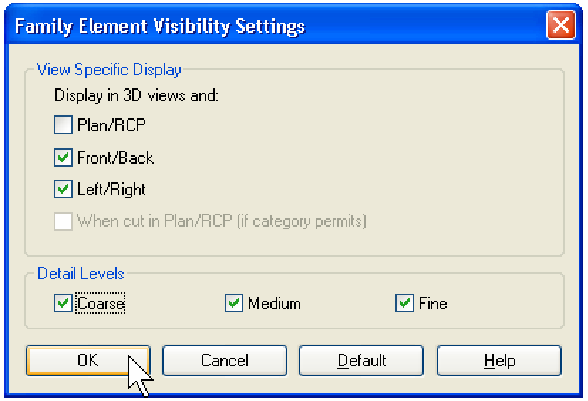
43. In the **Properties** dialog box for this geometry, associate the **Finish** parameters to **Material**.



44. Click the **Edit** button next to **Visible,** and clear **Plan/RCP**.

45. Click OK until you return to the drawing window.

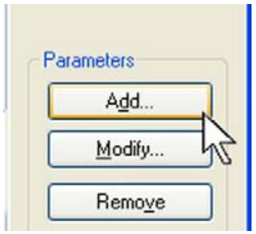
Everything is ready to embrace the new nested family. The next step is to load the family you want to nest and correctly link its parameters to the parameters of the shelf unit.

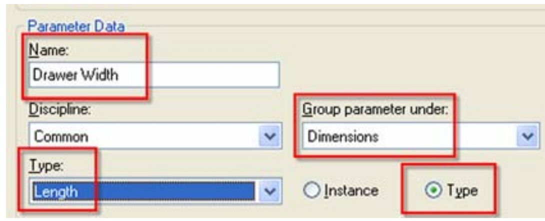


Create Drawer Parameters in Shelf Unit Family

46. On the Design Bar, click **Family Types**.

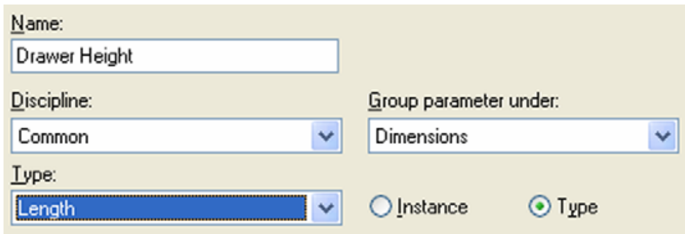
47. Click **Parameter Add** and set the following:
    a. Name = **Drawer Width**
    b. Group Parameter Under = **Dimensions**
    c. Type = **Length**
    d. Select **Type** radio button





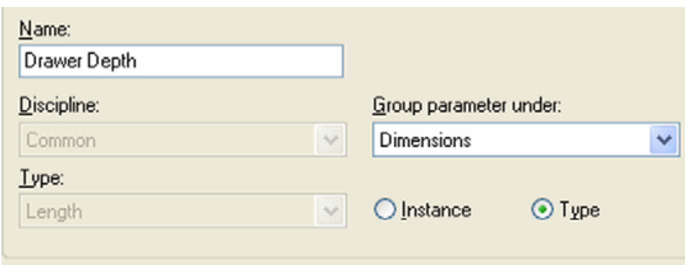
48. Click **OK** to return to Family Types dialog box.

49. Click **Parameter Add** to create Drawer Height parameter.
    a. Name = **Drawer Height**
    b. Group Parameter Under = **Dimensions**
    c. Type = **Length**
    d. Select **Type** radio button



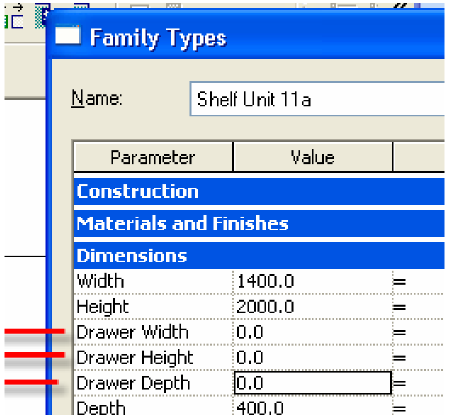
50. Click **OK** to return to Family Types dialog box.

51. Click **Parameter Add** to create Drawer Depth parameter.
    a. Name = **Drawer Depth**
    b. Group Parameter Under = **Dimensions**
    c. Type = **Length**
    d. Select **Type** radio button
52. Click **OK** to return to Family Types dialog box.



53. Verify the parameters in the Family Types dialog box.

54. Click **OK** to return to the drawing window.



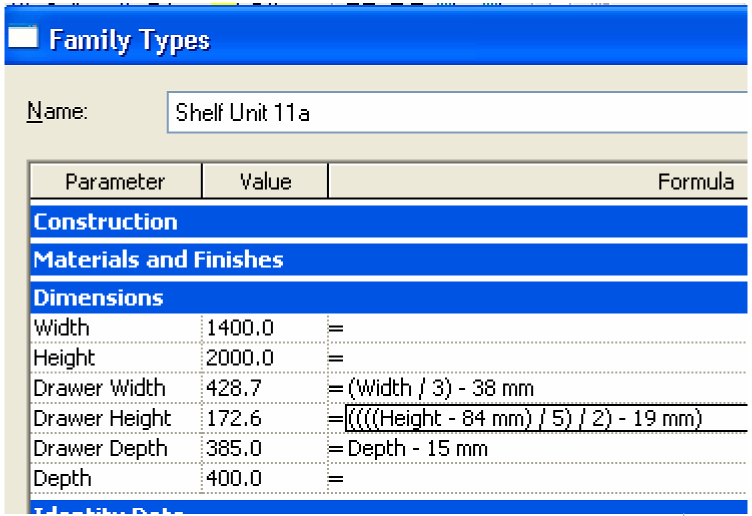
The parameters have been created and are available for use.

Create Formulas for the Drawer Parameters

55. Now, in the **Family Types** dialog box, in the **Drawer Depth, Drawer Height,** and **Drawer Width** lines, enter the formulas as shown in the image.

56. For Autodesk Revit Building to understand the formulas you have just entered, it is necessary to respect case (for Revit Building, width isn't the same as Width). The suffix "mm" is automatically added when you confirm your formula, so it's not necessary to enter it.

57. Click **OK** to confirm all.



58. Click **Apply** to test your formulas as you create them.

Type the formula and click the Apply button. If everything is correct, the calculated width shows up in the value column. Revit Building alerts you to any errors.

59. Click **OK**.

60. Save the family.

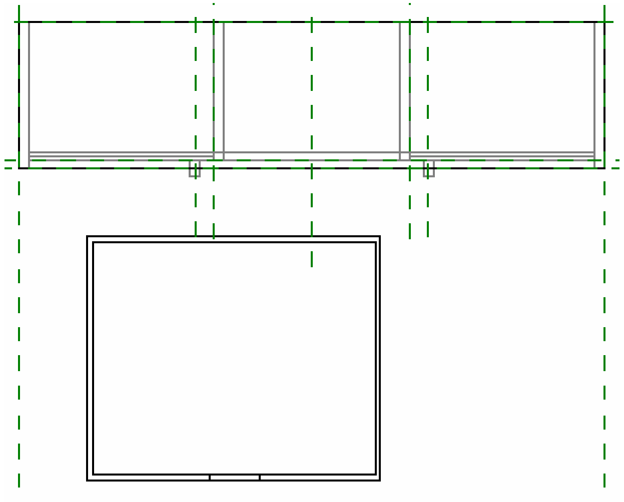
Load, Place, and Position a Drawer

In this section you nest the drawer family into the shelf unit family.

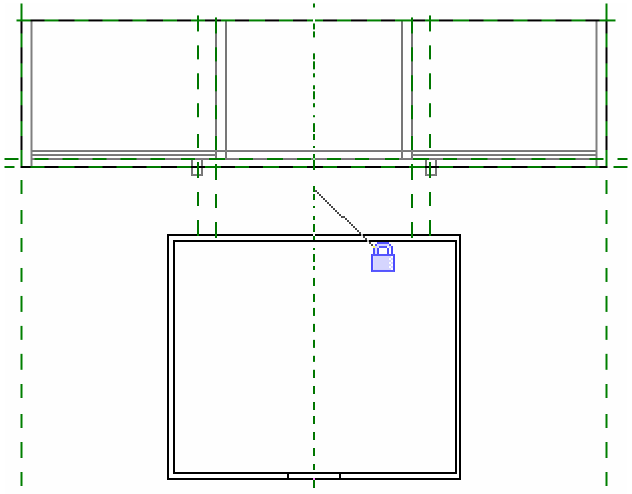
61. From the File menu, choose **Load from Library/Load Family.**

62. Browse to find the drawer family (you have to remember where you saved it) and click **Open**.

63. Set the Ref Level view current.
64. On the **Design Bar**, click **Component** and insert one instance of the drawer family in the shelf unit.



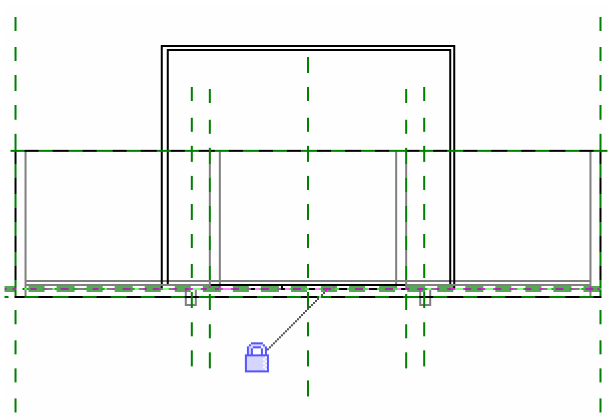
65. Using the **Align** tool, align the axis of the drawer to the axis of the shelf unit and lock this alignment.



When you place the cursor in align mode over the axis of the drawer, Autodesk Revit Building displays a thick black line indicating the reference plane of the drawer family.

66. Align the front of the drawer to the second reference plane from the bottom (see image).

67. Lock this alignment as well.



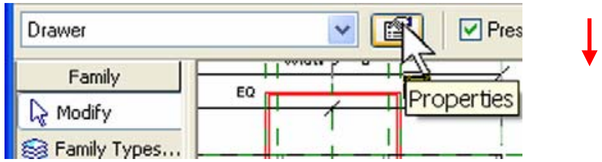
For a perfect match of the drawer family in the shelf unit, you need to link the parameters of both families.

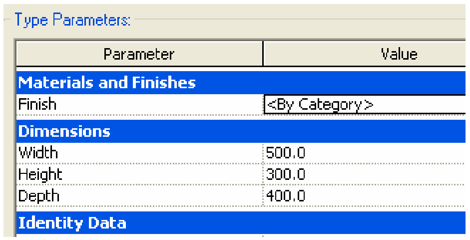
Link Parameters from the Shelf Unit Family to the Drawer Family

68. On the Design Bar, click **Modify** and select the drawer.

69. On the **Options Bar**, click **Properties**.

70. In the Element Properties dialog box, click **Edit/New** to view the type properties of the element and thus the drawer parameters.





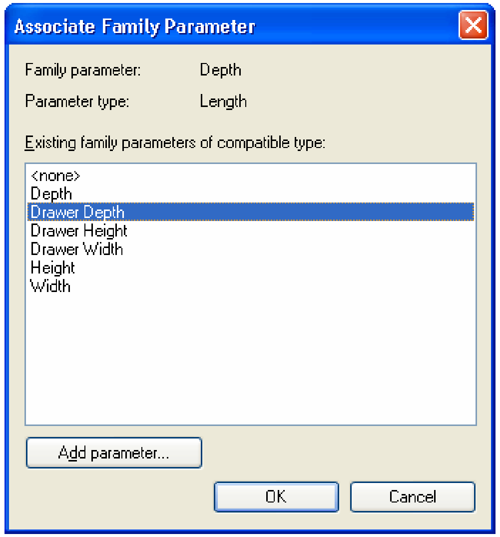
The element properties are the same properties you would expect to see if you loaded this family into a project.

Use the small gray boxes at the far right of the Width, Depth, Height, and Finish parameters to make the link between the parameters.

71. Click the small gray box in the **Depth** line and select **Drawer Depth** in the **Associate Family Parameter** dialog box. Click **OK**.

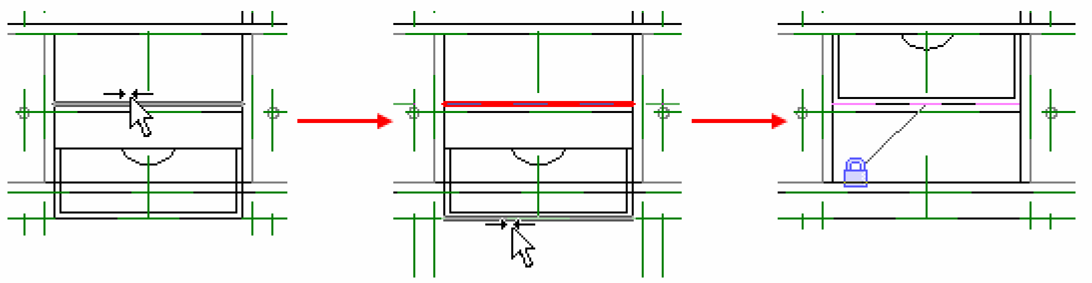
72. Repeat for all three parameters and associate them as follows:
    - Width = **Drawer Width**
    - Height = **Drawer Height**
    - Finish = **Finish**

73. Click **OK** until you return to the drawing window.



74. Activate the **front** view, and using the **Align** tool, align and lock the drawer in the upper empty space.

75. If you have trouble selecting the lower line of the drawer, just position your cursor near that line and use the Tab key until that line is activated, then click to select it. (The Tab key is a great help whenever you have overlapping geometry.)

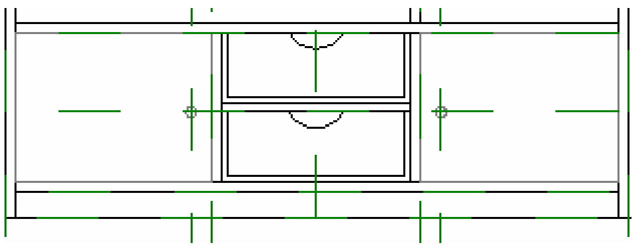


76. Switch to the **Ref Level** view.

77. Repeat the same method to insert, align, and lock the second drawer.

78. Switch to the front view and repeat aligning and locking vertically.

79. Test the family by flexing the model.

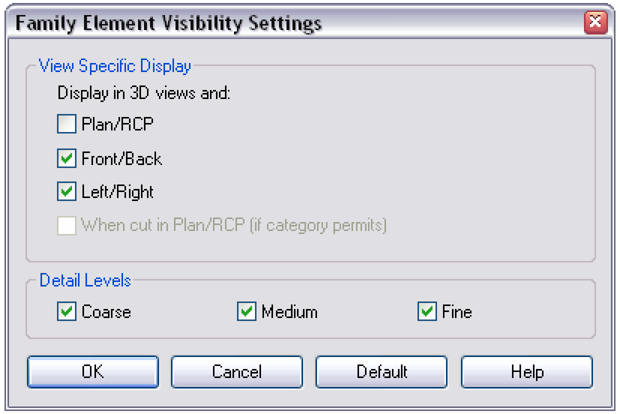


Because all drawer parameters are Type parameters, you do not need to repeat the same for the second drawer. The new drawer instance automatically inherits the instance properties of the existing one. All you need to do is align it in plan view and in elevation.

80. Select both drawers, and on the Options Bar click **Visibility**.

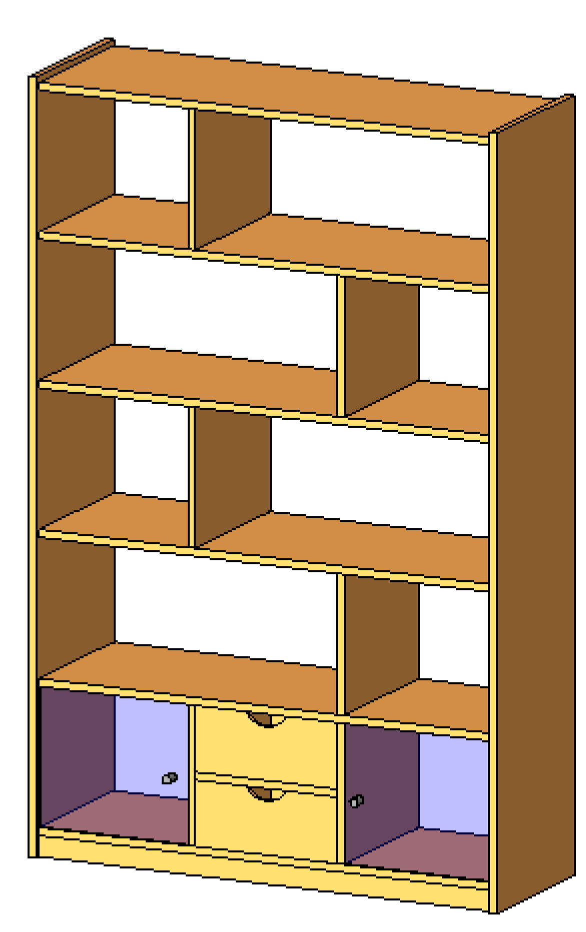
81. Clear **Plan/RCP**.

82. Click **OK**.



If you are daring, try copying the drawer in elevation instead of reinserting it in plan view. Can you get all the alignments in this front view?

83. **Save** your file.



You are almost finished with your family. But before you use it in a project, you might want to add subcategories. With subcategories, you can control the entire display of the family in all views (line thickness, line color, line style, material, and so forth).

Unit 11, Exercise E: Subcategories and Families

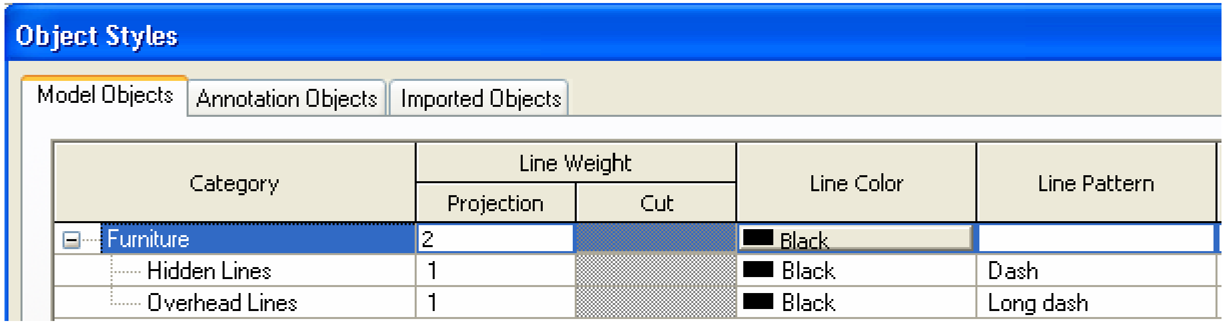
The family category was defined when you selected the template to make it with. You can change this template later, but it is *not* advisable to do so. Always make sure to select the correct template when you create a new family. Next, you set new subcategories within your family.

Create Subcategories of the Furniture Category

This exercise builds on work performed in previous exercises. If you have not completed the previous exercises, but want to work through this exercise on subcategories and families, open Workbook Data set**Unit 11e Shelf - Start.rfa**.

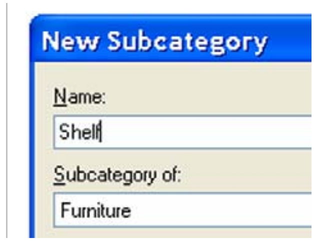
1. From the **Options** menu, choose **Object Styles**.

2. Scroll down to the Furniture category. By default there are two predefined subcategories: Hidden Lines and Overhead Lines. You need three new subcategories: Glass, Shelf, and Accessories.

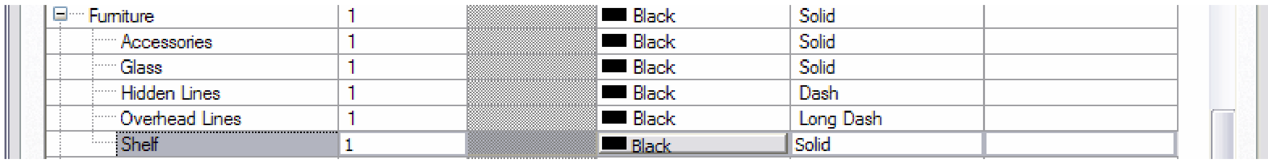


3. Click the **New** button.

4. Enter **Shelf** for Name, and under Subcategory of, select **Furniture**. Click **OK**.



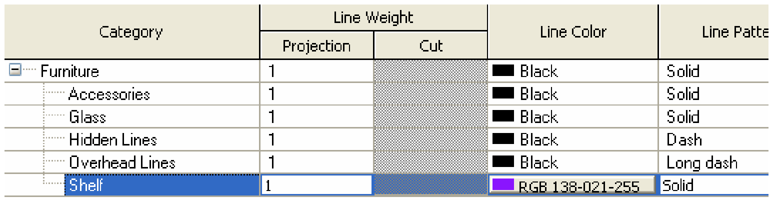
5. Repeat the same operation for **Glass** and **Accessories**.



For each subcategory, you can set whatever line thickness, color, or material you want. The material is assigned to the family subcategories only if under the Finish parameter the value is set to <by category>. Here, you simply change the color of one of the subcategories.

6. In the **Object Styles** dialog box, in the **Shelf** line, click the **Line Color** button.

7. Select any color from the **Color** dialog box and click **OK**.



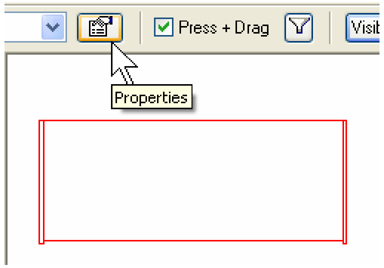
8. To see just the symbolic lines, activate the Ref. Level (Fine) and using the Hide/Isolate tool, hide:
   - Reference planes
   - 3D geometry
   - Nested families

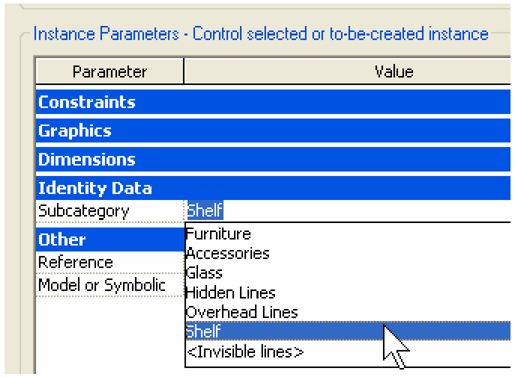
9. Select all these lines, and on the **Options Bar** go to their Properties.

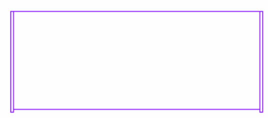
10. In the **Element Properties** dialog box, click **Subcategory** and select **Shelf**.

11. Click **OK**.

12. Repeat for the **Ref. Level (Coarse – Medium)**.







In principle, using the same method for both 2D and 3D, here are the associations you need to define:

- For all vertical separations, horizontal shelves, and the plinth, associate the Shelf subcategory.
- For the Glass doors, choose **Glass**.
- For the Doorknobs, choose **Accessories.**

The easiest way to select the geometry when associating the subcategories is to work in a 3D view.

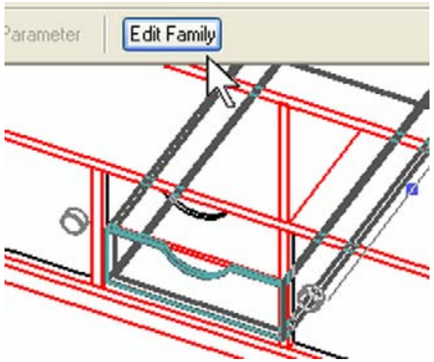
As for the drawers, if you have tried associating a subcategory to them, you will notice that there is no subcategory parameter within their properties. The reason is that the drawers are nested families. So, go back to the drawer family to effectuate this.

Use In-Place Family Editing to Modify the Drawer Family

Use the same process you used in an earlier exercise to access the drawer family and modify the shelf in the project file.

13. Select a drawer, and on the Options Bar click the **Edit Family** button.

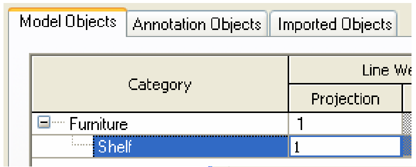
14. Click **Yes** to open the family for editing.

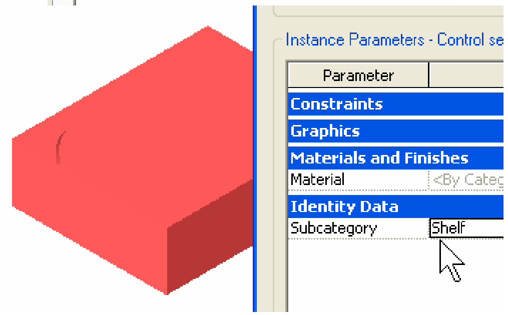


15. Click **Settings>Object Styles**.

16. Create a new subcategory **Shelf**.

17. Associate the entire geometry to this subcategory.



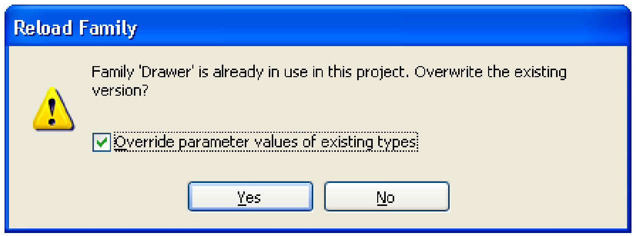


18. On the Design Bar, click the **Load into Project** tool.

19. Check the current shelf family you are working on.

20. Click **OK**.

21. Click **Yes** to overwrite.



In the next step you create a subcategory in the drawer family called Shelf (same as the subcategory in the family file). All geometry uses the existing shelf definition once it is loaded back into the family file.

Alternatively, you could create a subcategory called Bin. In this case, when loaded into the shelf family, it would bring this subcategory with it and you would then have direct control over this subcategory in the shelf unit family file. Likewise, when you load the shelf unit into a project, it brings all the subcategories, including Bin. You would then have access to this subcategory in the project file.

22. Use the Window menu to switch back to the drawer family.

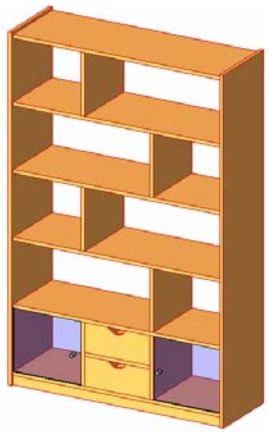
23. Close the drawer family.

24. Click **No** at the Save Changes prompt.

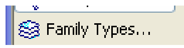
25. You should now be back at the shelf unit family.

26. Save the family.

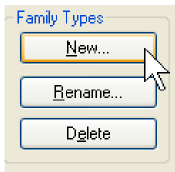
Create Types

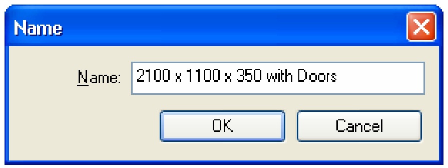


27. On the Design Bar, click **Family Types** and then click **New**.



28. As a name for the new type, enter **2100 x 1100 x 350 with Doors**, and click **OK**.





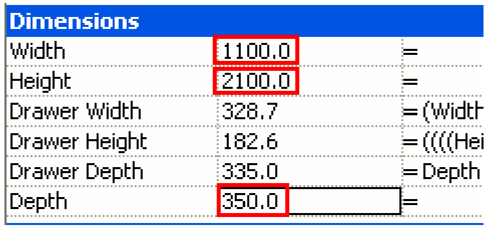
You can save the changes if you want. If you do so, the software tries to locate where the original drawer family file came from when it was loaded into the family.

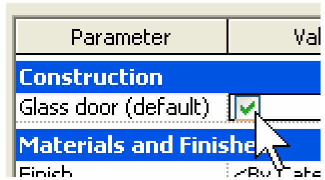
You do not need to save because the changes have already been loaded into the shelf unit family.

The drawers assume the properties of the shelf subcategory defined in the shelf unit family.

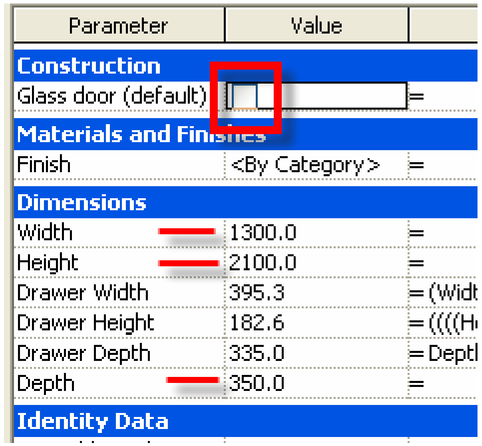
The family is finished and is fully parametric. What you still can do is create types. In other words, you can preset different types of this family with predefined parameters like width, depth, height, and material so the shelf unit can automatically be inserted in various standard sizes or materials, enabling users to simply select the type from a list. Should the type not be found on that list, the user can always create it on the fly. Let's see how to do that.

29. You can now change the corresponding values in the dialog box.

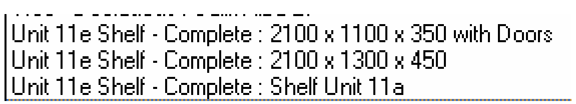




30. Create a new type **2100 x 1300 x 450** and click **OK.**
31. Adjust the parameters to **Width (1300)**, **Height (2100)**, **Depth (450),** and clear the **Glass Door** check box.
32. Click **OK**.
33. From the **File** menu, choose **Save**.

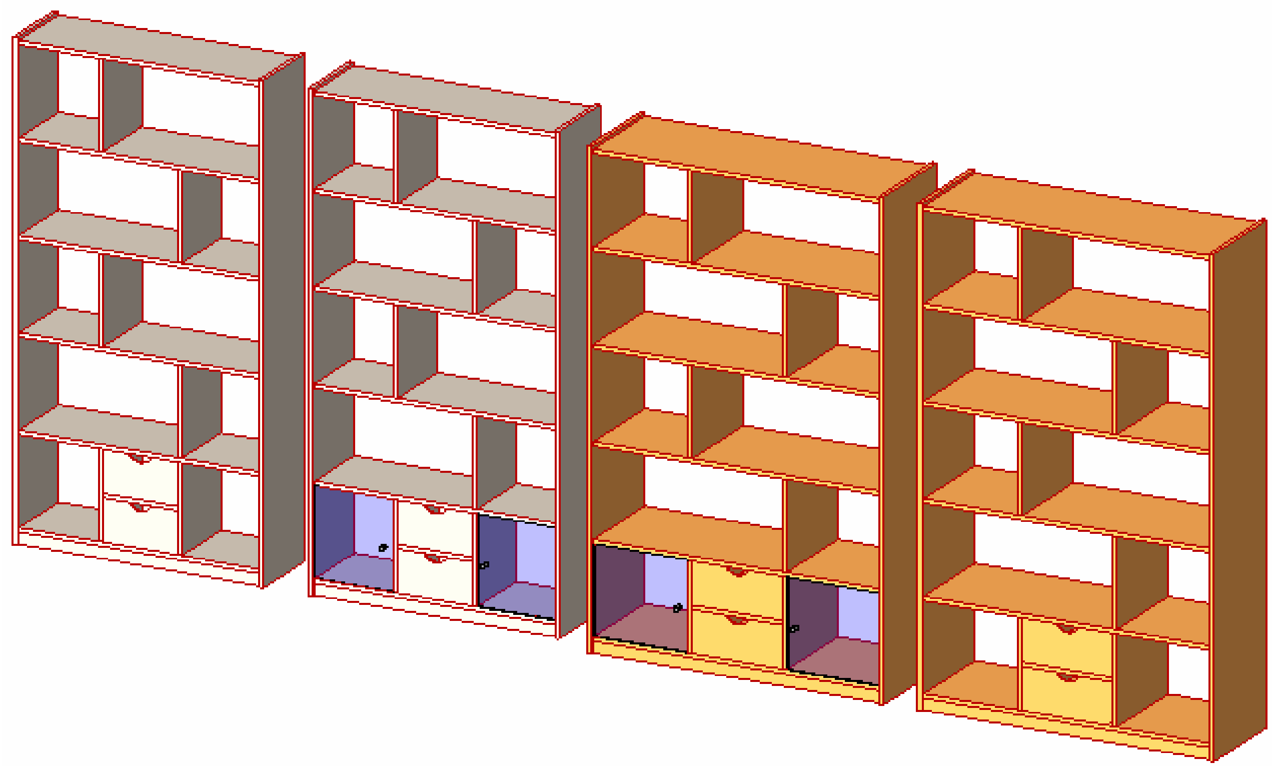


34. Start a new project or open an existing one. Load the newly saved shelf unit family and insert a few instances of it in the project. Note that in the unit's Properties dialog box under **Type,** you see two or three different predefined types of this family.



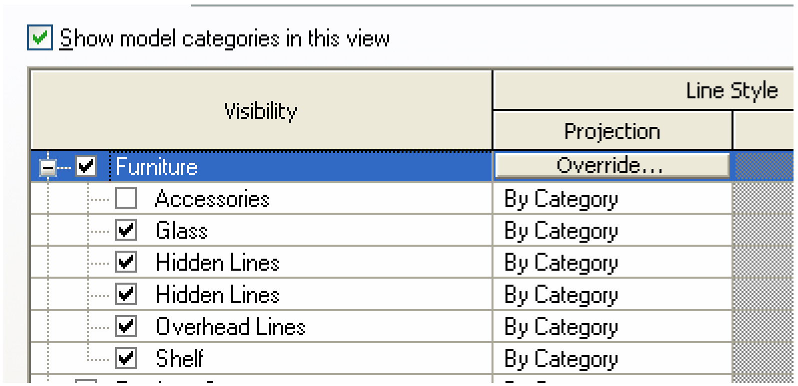
The family name is displayed along with the type name. The family in this case is the name of the RFA file you have been working in.

35. Insert a few instances of each type and change their parameters to see the differences. Try to change both the instance parameters (Glass Door) as well as the type parameters (width, height, and so forth). Remember that you will not see the door pulls unless the view is set to Fine.

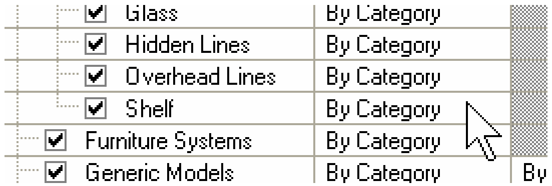


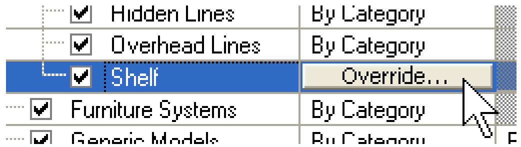
36. Activate **Level 1** and in the Properties of the view, click **Visibility** Edit button.

37. Expand the **Furniture** category.

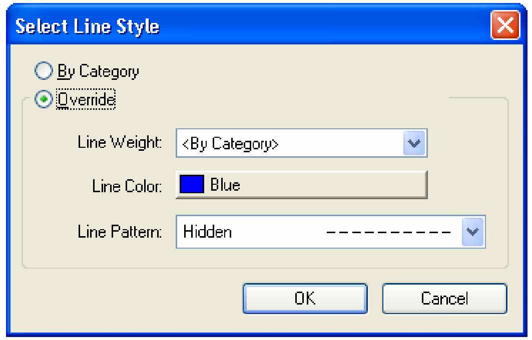


38. Click **By Category** in the Projection column in the Shelf line to override.

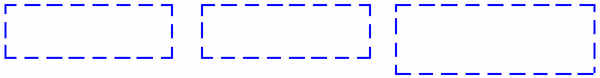




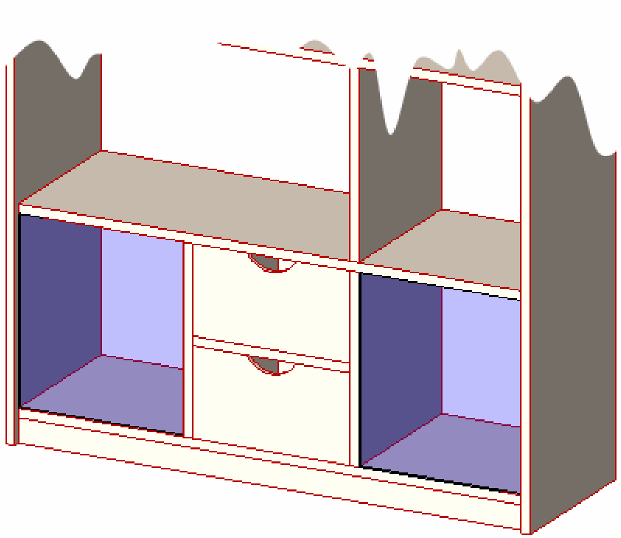
39. Change the Line Color and the Line Pattern and click **OK**.



40. Make sure the changes you have just made are propagated correctly.



41. Activate the **3D** view, and in the Properties dialog box click **Visibility**.
42. Expand the **Furniture** category.
43. Clear **Accessories** and click **OK**.



Again, thanks to the subcategories, you can have an instance of this family in which the doorknobs are simply turned off and thus invisible.

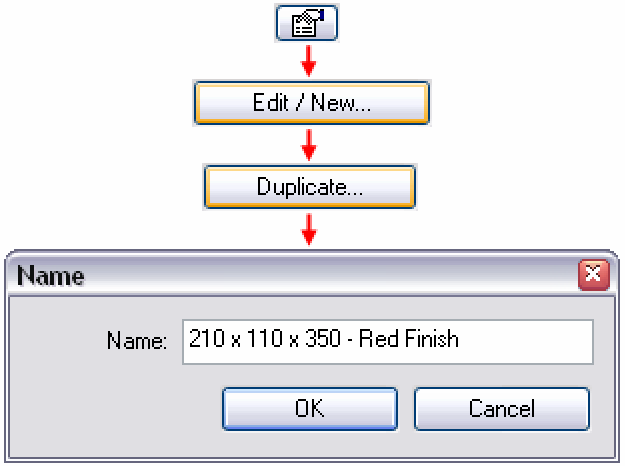
If you do not see the accessories in the view, remember these are set to Fine.

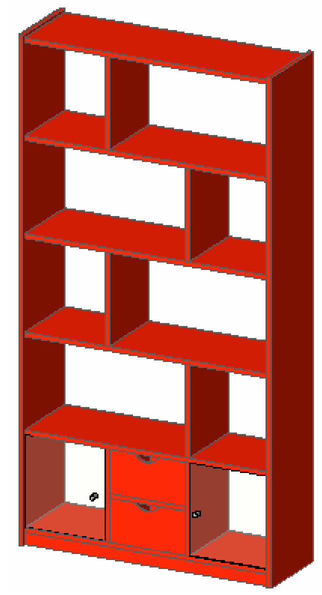
44. Select any instance of the shelf unit, go to its **Properties** dialog box, and click **Edit/New**.

45. In the dialog box that opens, select **Duplicate**. Autodesk Revit Building prompts you to enter a new name: you are about to create a new type of this family. Name this new type **210 x 110 x 350 – Red Finish** and click **OK** to close all dialog boxes.

46. Create a red paint material and click OK to close all dialog boxes

47. You have just created a new type of this family.





You can create as many types of a family as you want, and they don't exist only in this project but can be used in any other project.

Unit 12

Theory: Interdependencies

Autodesk Revit Building: Site

This unit explains Autodesk Revit Building's Site features and workflow as well as linking files and AutoCAD drawings. This unit has four exercises.

- 12a takes you through the process of creating importing an AutoCAD drawing.
- 12b illustrates how to link a Revit Building project into a current project.
- 12c works with the site tools to develop the model.
- 12d exports a view and sheet into AutoCAD DWG format.

Unit 12, Exercise A: Importing AutoCAD Drawings

In this exercise you start with the workbook template and import an AutoCAD drawing to use as a basis for the site work in the rest of this unit. This AutoCAD site drawing has polylines that are placed at elevation. In a later exercise you will convert this geometry to a Revit Toposurface.

Exercise Setup

1. Start a new project with the workbook template.

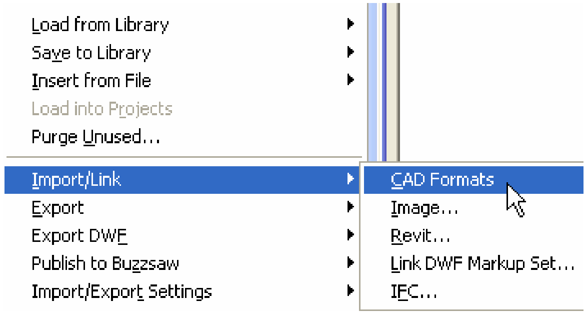
Refer to Unit 1 if you need help creating a project from the workbook template.

2. From the File menu, choose **Save As** and save your project as *Unit 12.rvt* in the Revit Workbook folder.

3. Set the Site view current.

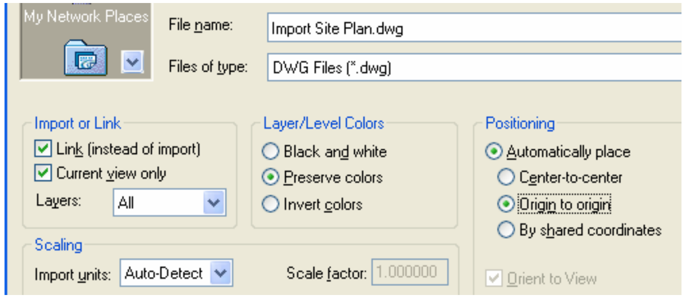
Import an AutoCAD Drawing

4. From the File menu, choose **Import/Link>CAD Formats**.



5. Browse to and click once on the drawing file *Import Site Plan.dwg* in the workbook folder.

6. Match the settings in the Import dialog box to the settings shown at right:
   a. Link (Instead of Import)
   b. Current View Only
   c. All layers
   d. Preserve colors
   e. Automatically place: Origin to Origin



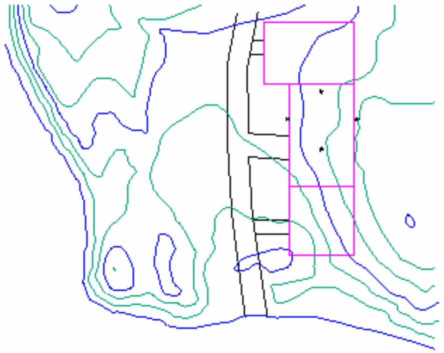
Link Instead of Import: This option maintains a live link to the drawing. If the drawing changes, you can reload it into the Revit Building project.

Current view only: It is a good idea to link drawings to a specific view. This approach cuts down on the amount of information needed to be regenerated as you switch from view to view.

Origin to Origin: Although you do not have access to the project origin as in AutoCAD software, the origin is near the intersection of the elevation marks.

7. Click the **Open** button to proceed with the import.

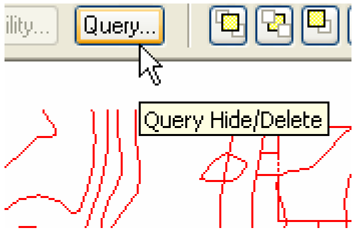
8. Right-click in the drawing area and click **Zoom to Fit**.



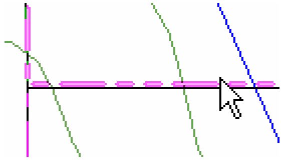
Layer Control of Linked Drawing: Query

9. Click the imported DWG in the drawing window.

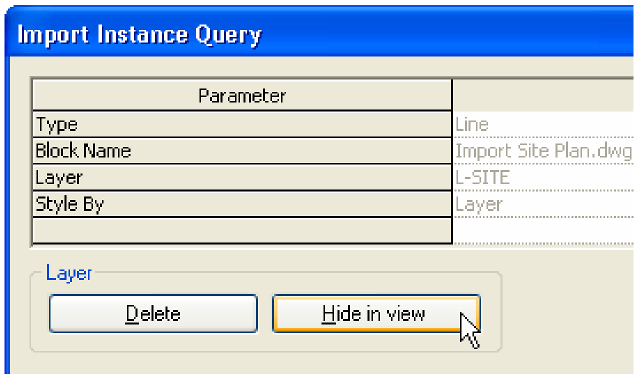
10. On the Options Bar, click the **Query** button.



11. Click one of the magenta lines in the drawing.



12. Click Hide in View.



The Query dialog box is a convenient way to find out information about the object you have selected in the linked drawing.

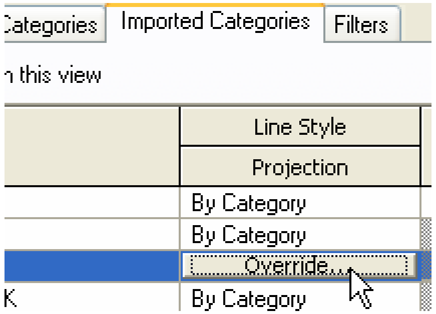
Layer Control of Linked Drawing: Visibility Graphics

In addition to the on-off control afforded by the Query tool, you have complete control over the linework in the linked drawing though the visibility graphics override of the view.

13. Type **VG** to access the view's visibility graphics override.

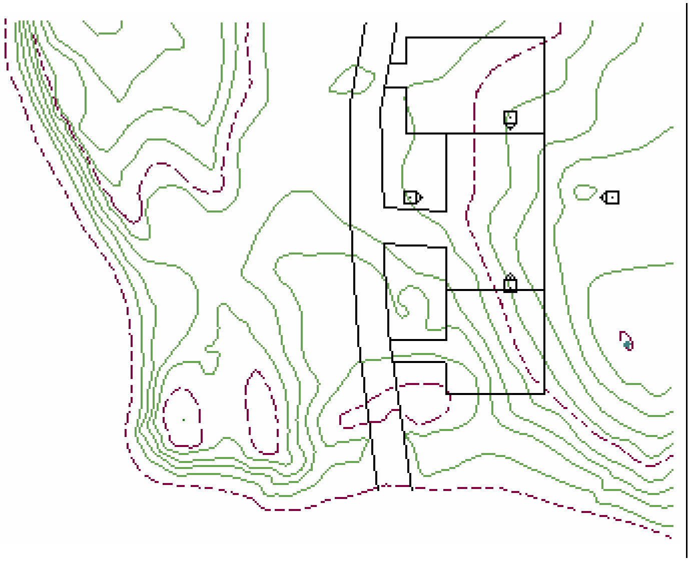
14. Click the **Imported Categories** tab.

15. Click the Line Style for Major Contour to access the override for this layer in the linked drawing.



16. Set the line color to a purple or dark red and the line pattern to Long Dash.

17. Click **OK** two times to return to the project's drawing window.



The linked drawing now has overrides for this specific view.

Unit 12, Exercise B: Importing Revit Building Projects

In this exercise you continue from exercise 12a, but import a Revit Building project with a building in it. You then look at some of the display controls you have over the linked Revit Building file. If you completed the last exercise, you can continue to work in that file. If you choose to work in the provided project file, note that for consistency the AutoCAD drawing has been inserted rather than linked.

Exercise Setup

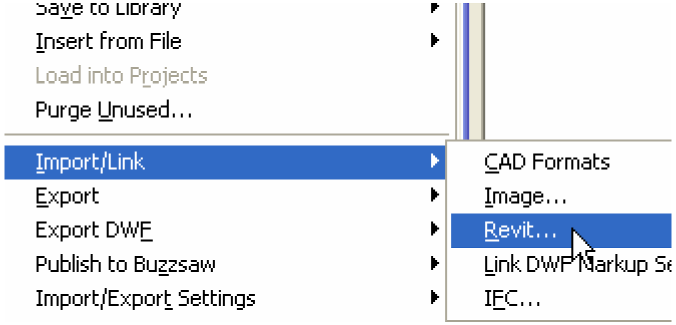
1. Open file **Unit 12b – Start**. You should be in site view.

Link a Revit Building Project into the Current Project

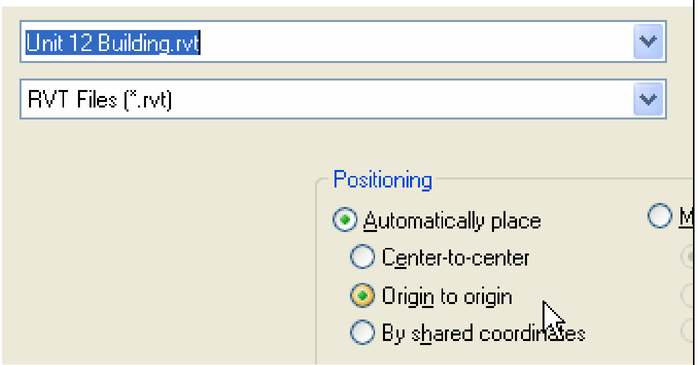
Revit Building files may be linked into one another. Like the linked AutoCAD DWG file, as the linked Revit Building file changes, it may be reloaded to update the current project with the new information. Also like the linked DWG, you have control over how the linked Revit Building file is displayed in the current view.

Unlike the AutoCAD drawing file there is no way to insert a Revit Building project into another project completely. It will only import as a linked file.

2. From the File menu, choose **Import/Link>Revit**, and browse to the workbook's data set folder. Click one time on Unit 12 Building.rvt.



3. Select the **Origin to Origin** option under Positioning Automatically Place, and click the **Open** button.

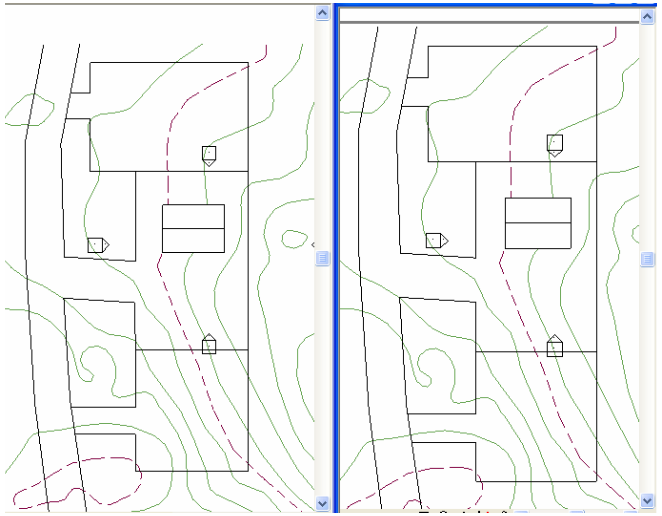


Linked Revit Building Project by View

You have several levels of control over the display of the linked Revit Building file. You can view the linked file with the default visibility of the view, or the default settings of a view within the linked file, or override any of the linked constituent parts.

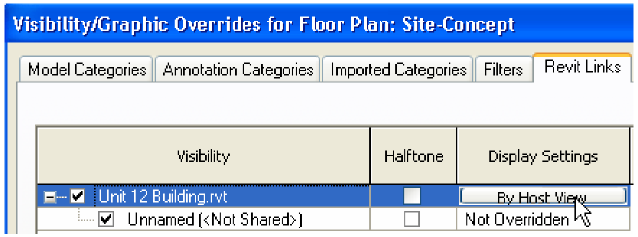
4. Duplicate with detailing the Site view and rename the new view Site-Concept.

5. Tile the Site and Site-Concept views.



6. Set the Site-Concept view current, and type **VG** to access the view's visibility graphics override.

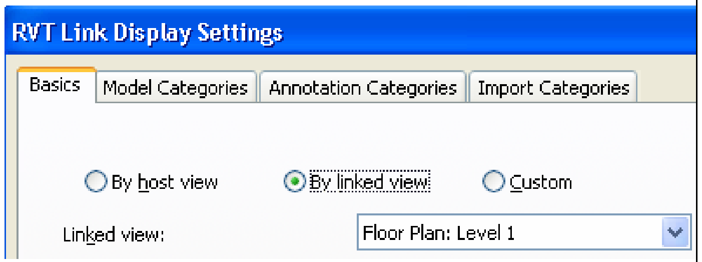
7. Click the **Revit Links** tab and then click the plus (+) sign to the left of Unit 12 Building.rvt.



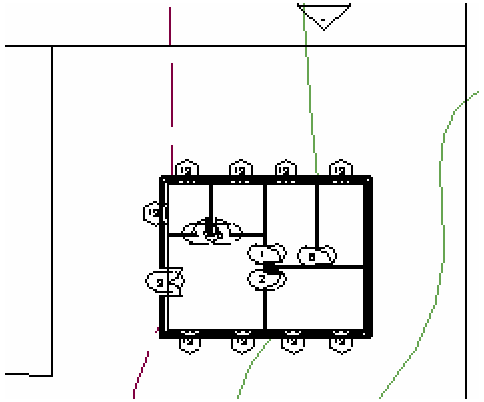
If you have more than one instance of the linked file in your project, each instance is listed in this tree. You control the display of each instance independently.

8. Under Display Settings, click the By Host View button to override the default display settings.

9. In the RVT Link Display Settings dialog box, click the **Basics** tab, and then click the **By Linked View** radio button and set the linked view to Floor Plan: Level 1.



10. Click **OK** two times to return to the drawing window.



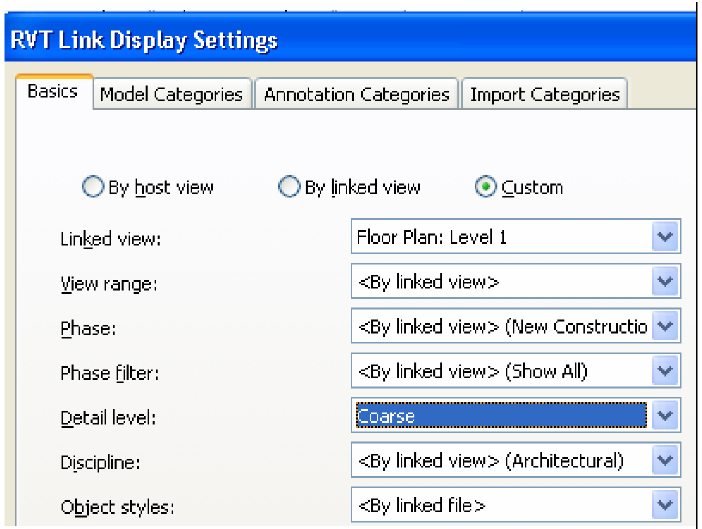
The linked file now uses the current display settings stored by the linked file rather than the host file's current view settings.

Linked Revit Building Project View Display Override

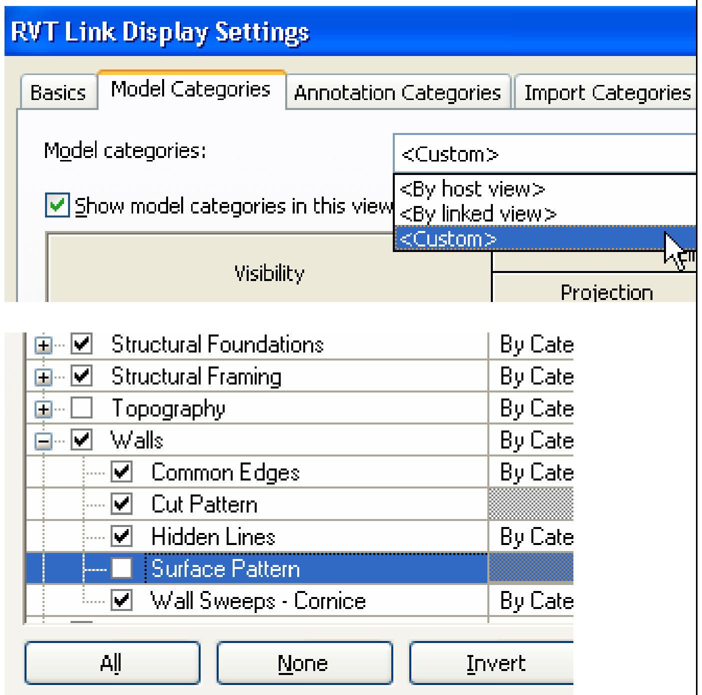
You can also control each item in the linked file independently of the view settings stored in the linked project files view.

11. With the Site-Concept view current, type **VG** to access the view's visibility graphics override.

12. In the RVT Link Display Settings dialog box, click the **Basics** tab, and then click the **Custom** radio button.
    a. Verify the Linked View is set to Floor Plan: Level 1.
    b. Change the Detail Level to Coarse.

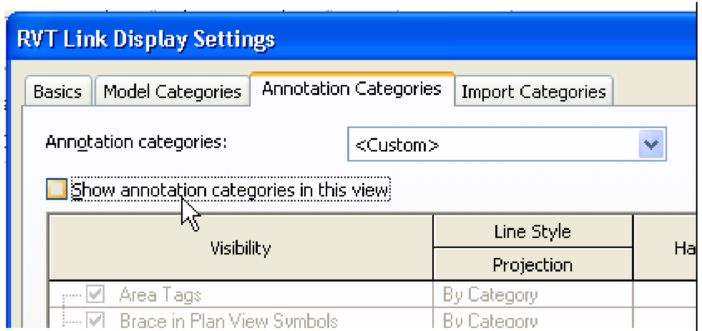


13. Click the **Model Categories** tab:
    a. Set the Model Categories drop-down to **<Custom>**.
    b. Under Walls, clear the **Surface Pattern** check box.

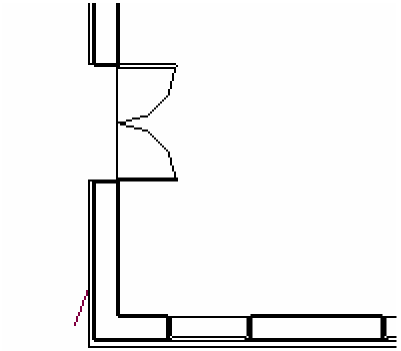


This step turns off the wall hatch you see on the reveal at the base of the wall.

14. Click the Annotation Categories tab:
    a. Set the Annotation Categories drop-down to **<Custom>**.
    b. Clear the **Show Annotation Categories in This View** check box.



15. Click **OK** two times to return to the drawing window.



All of the view visibility controls can also be applied to a linked Revit Building project.

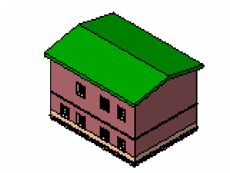
Unit 12, Exercise C: Site Tools

Autodesk Revit Building software's site features and workflow are explained in this unit.

1. Open file Unit 12 – Start. You should be in site view.

The site file has an imported DWG instance. The DWG data consists of 2D polylines on different heights.

2. Set the 3D view current.

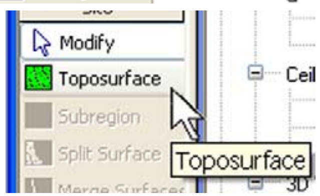


Note that the DWG drawing was imported as "Current view only" so it displays only in the view where it was positioned—the Floor Plans Site view. It does not appear in the 3D view.
It is a good idea when you link in AutoCAD site drawings to link them into only one view. You will create a toposurface that shows the site grading in 3D, section, and elevation.

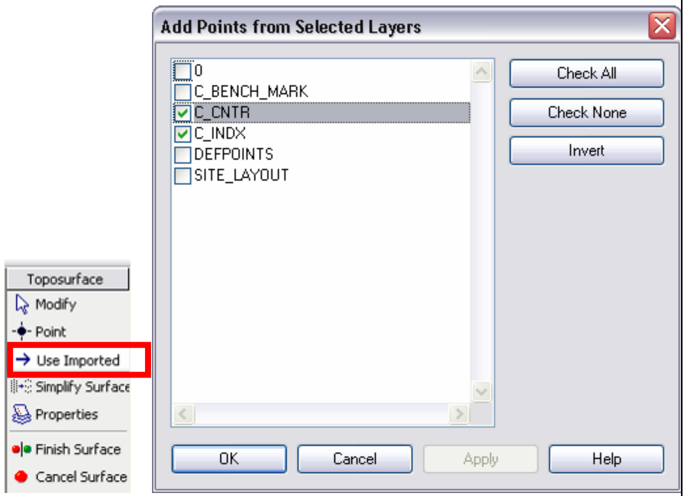
3. Set the Floor Plans Site View current.

4. Right-click the Design Bar and activate the Site Design Bar if it's not already visible.

5. On the Design Bar, click Toposurface. You enter sketch mode.



6. On the Design Bar, click Use Imported and then click the imported DWG file.



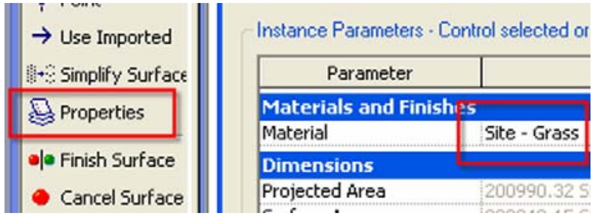
Toposurfaces can also be created directly by clicking the Point command and positioning points (the height can be set on the Options Bar) in the workspace.

Site information is usually imported from a DWG file.

7. Use image on the right to select the layers to use for creating the surface. Click OK.

Once the DWG instance has been selected, Autodesk Revit Building recognizes the layers contained within it and lets you pick which ones you want to use to create the surface.

8. On the Design Bar, click Properties and change the surface material to Site – Grass. Click OK to close the dialog box.



You can change surface material later by opening its Properties dialog box.

9. On the Design Bar, click Finish Surface.

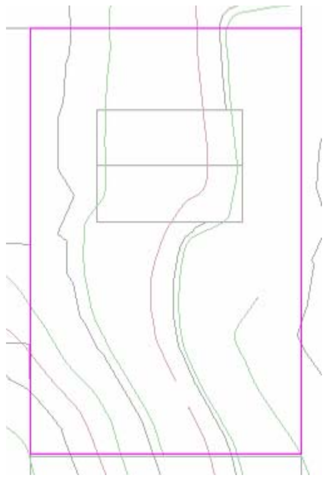
10. Open a 3D view. Note that the building is sunk inside the topographic surface.

11. Open site view again.

Note that the DWG drawing was imported as “Current view only” so it displays only in the view where it was positioned.

Create a Pad

16. On the Design Bar, click Pad. You are once again in sketch mode.
17. Use the Lines tool to draw a rectangle around the building, as shown in the image. You can follow the property lines for the sketch.

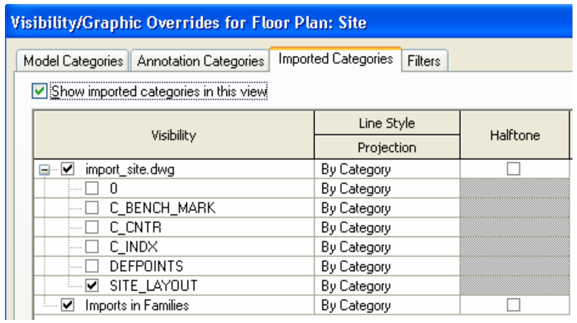


These property lines were sketched, but you can enter their coordinates directly in a table and the sketch is automatically generated.

18. On the Design Bar, click Pad Properties, and change the Pad Level to Level 1.

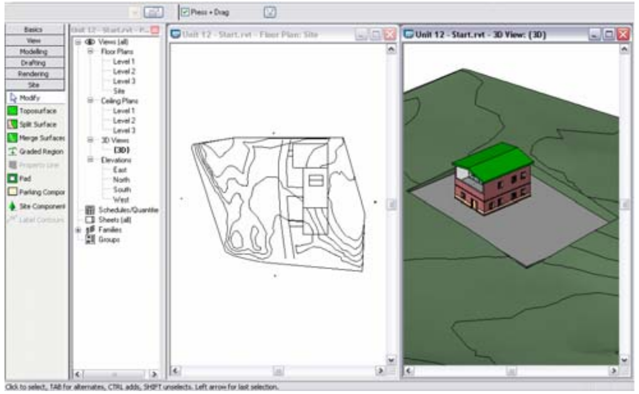
Change this property at any time.

19. Click Finish Sketch.
20. Open the visibility settings for the view, go to the Imported Categories tab, and turn off visibility for all the DWG layers except Site Layout.
21. Click OK to exit the Visibility Graphics dialog box.
22. Click OK to exit the View Properties dialog box.



Turn off the unnecessary DWG data in your view.

23. Open the 3D view to see the pad. Tile windows (choose Tile from the Window menu).



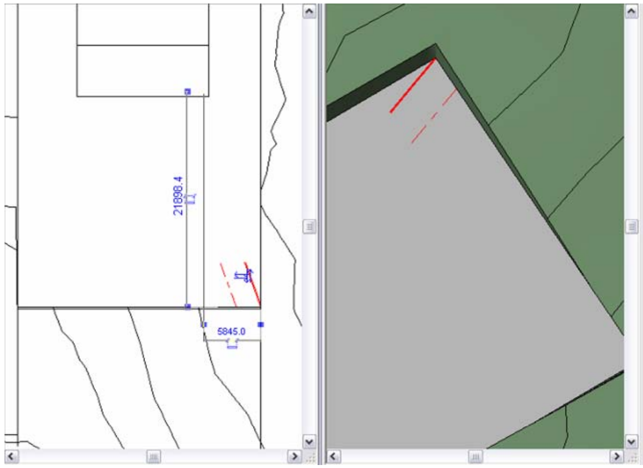
Working with side-by-side windows is helpful in many situations.

Before you tile the windows, choose Close Hidden Windows from the Window menu, and then open just the views you want to tile.

If you minimize a view, it does not tile with the other open views.

Add Site Components

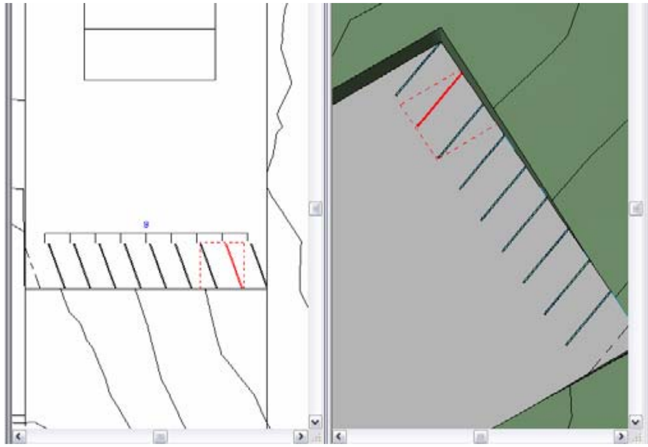
24. Set the Floor Plans : Site Plan Current.
25. On the Design Bar, click the Parking component, and add a 4800 x 2400mm - 70 deg as shown in image.



Parking components, as site components, automatically recognize the height of their host during positioning.

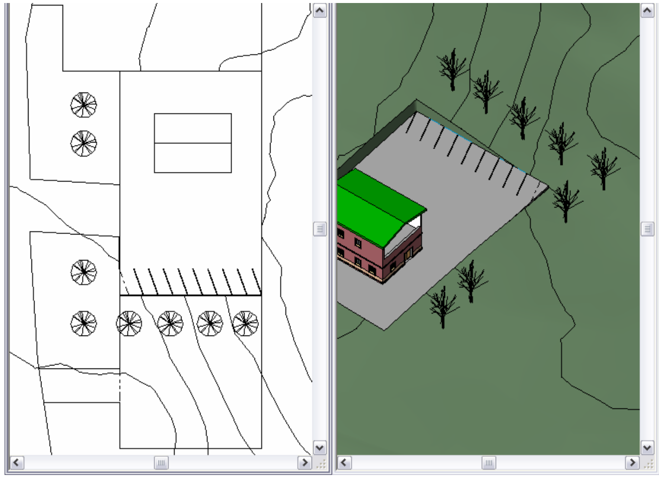
Use the blue arrows to flip the parking space.

26. Select the parking component and array nine instances of it to the left (west).



Parametric arrays are helpful when positioning this kind of component.

27. Click Site Component, and add a few tree components, as shown in image.



Trees are specific site components that have their own editor and can be customized, though Autodesk Revit Building comes with an extensive tree library.

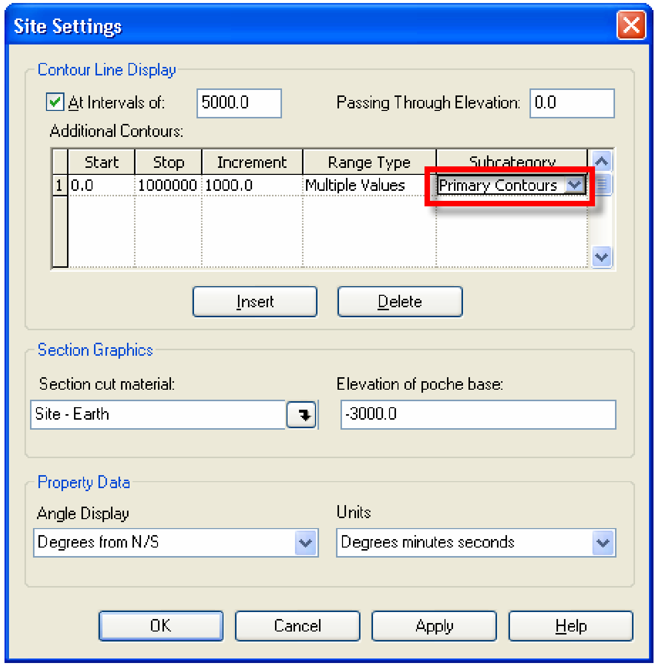
To navigate through the library, create a new planting family and open the Family Types dialog box. Clicking the Plant Name parameter opens an AccuRender dialog box with the tree library.

The symbol used for plans, elevations, sections, and normal 3D is a simple stick symbol.

Change the Site Settings

28. Maximize the site view. From the Settings menu, choose Site Settings.

29. Change the settings for the first row from Secondary Contours to Primary Contours (see image).

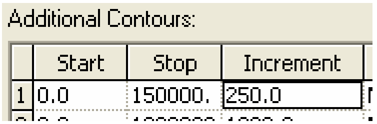


You can add as many contour lines as you want.

The poche base elevation setting in the bottom left defines how thick the surface displays in section views.

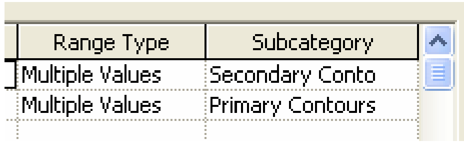
The Cut material defines what type of hatching the poche has.

30. Click Insert to add other secondary contours and apply the following settings:
   - Start: 0
   - Stop: 100m
   - Increment: 250
   - Range type: multiple values
   - Subcategory: secondary contours



Once finished, if you zoom in the drawing you see that primary and secondary contours display with different lineweights, which are set in the Object Styles dialog box under the Topography category.

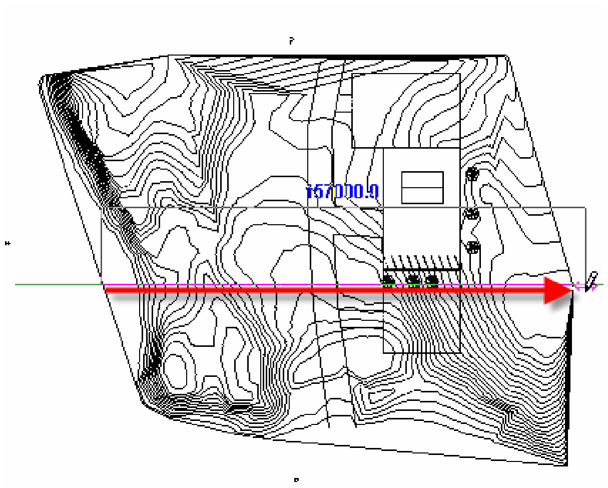
31. Click OK to exit dialog box. Note the additional contours that appear on the toposurface.



Range Type	Subcategory
Multiple Values	Secondary Conto
Multiple Values	Primary Contours

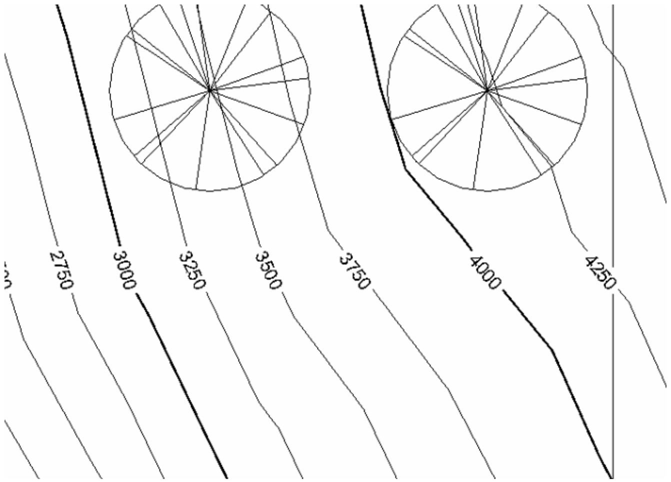
Add Contour Labels

32. On the Design Bar, click **Label Contours** and draw a straight horizontal line, approximately as shown in image.



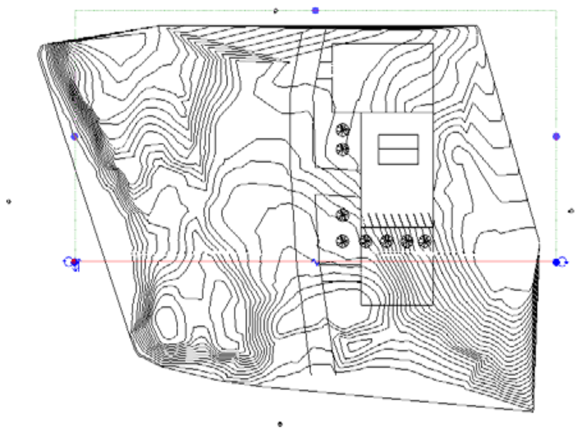
You can draw the Contour Label line in any direction.

33. Zoom in to see the labels.

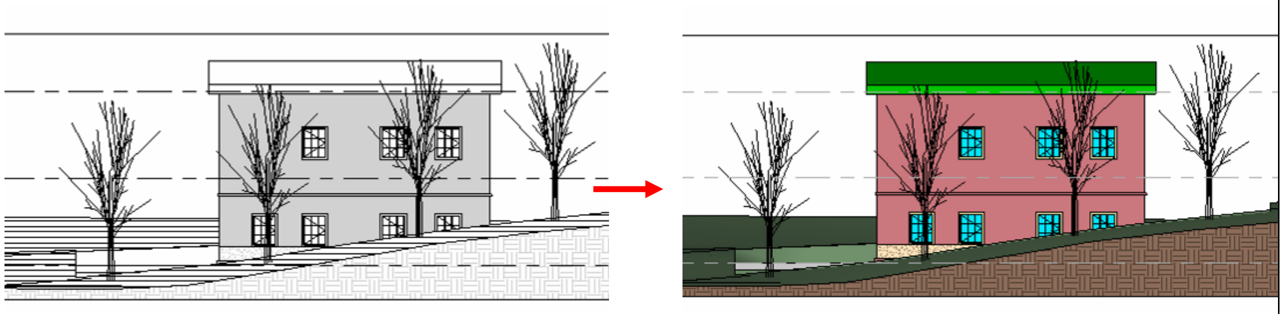


Add a Site Section

34. On the **View** Design Bar, click **Section** and draw a section on the same line as the contour label line.



35. Open the section. From the View menu, choose **Apply View Template**>**Site Section**.

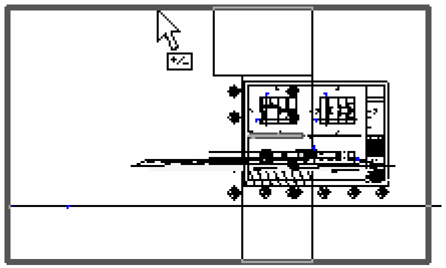


Unit 12, Exercise D: Exporting AutoCAD Drawings

In this exercise you export the site model and a sheet for use with AutoCAD software.

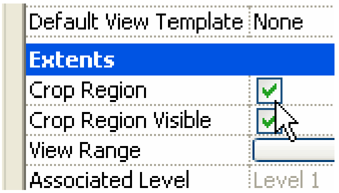
Exercise Setup

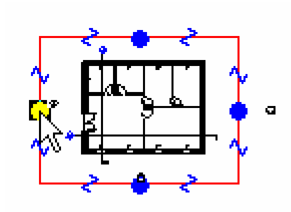
1. Open file **Unit 12d – Start**. You should be in site view.
2. Open the Sheet A101 and zoom out to see the extents of the views.



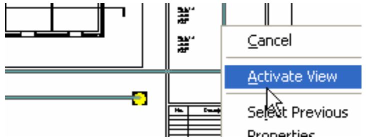
The views that were placed on the sheet have grown because of the site work now makes the extents of the views much larger than when the views were originally placed on the sheet. This is typical behavior if a view does not have its crop region active.

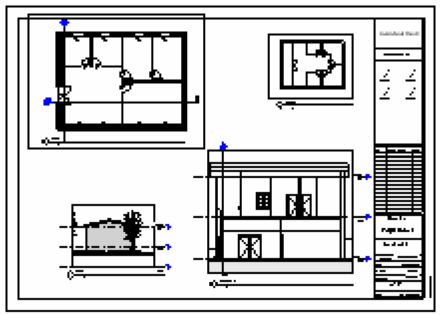
3. For each of the views on the sheet:
   a. Open the view properties and select in the Crop Region check box.
   b. Select and left drag the crop region into a more sensible boundary for the view.





You can also access the view properties from the sheet by selecting a view on the sheet and clicking Activate View from the context-sensitive menu.



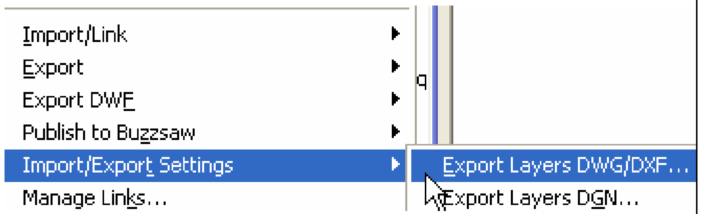


The finished sheet is now ready to export to AutoCAD software.

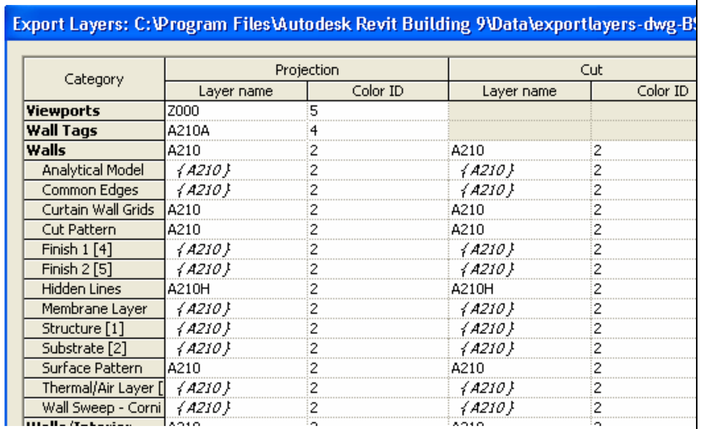
Export a Sheet to AutoCAD Drawing Format

Before you export to AutoCAD, verify that the export settings are correct.

4. From the File menu, choose **Import/Export Settings>Export Layers DWG/DXF**.



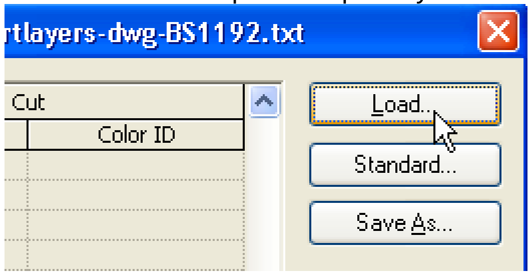
5. Make any changes needed to the export settings.



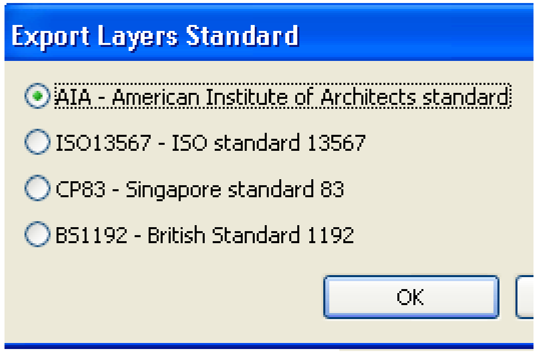
Category	Projection		Cut	
	Layer name	Color ID	Layer name	Color ID
Viewports	Z000	5		
Wall Tags	A210A	4		
Walls	A210	2	A210	2
Analytical Model	{A210}	2	{A210}	2
Common Edges	{A210}	2	{A210}	2
Curtain Wall Grids	A210	2	A210	2
Cut Pattern	A210	2	A210	2
Finish 1 [4]	{A210}	2	{A210}	2
Finish 2 [5]	{A210}	2	{A210}	2
Hidden Lines	A210H	2	A210H	2
Membrane Layer	{A210}	2	{A210}	2
Structure [1]	{A210}	2	{A210}	2
Substrate [2]	{A210}	2	{A210}	2
Surface Pattern	A210	2	A210	2
Thermal/Air Layer [	{A210}	2	{A210}	2
Wall Sweep - Corni	{A210}	2	{A210}	2

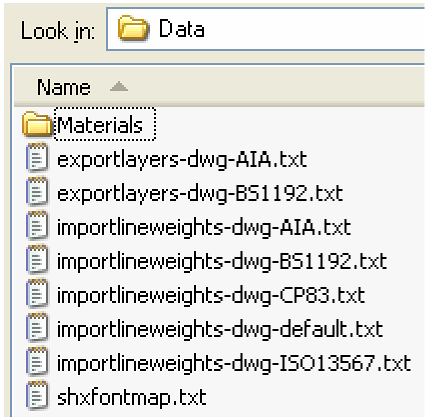
Each of the Revit Building objects is assigned a layer and color ID for instances where the object is cut (such as a wall in plan view) or as projection (a wall in elevation). The Layer names are created automatically in the new drawing file. The color IDs are the standard AutoCAD ACI colors that will be assigned to the layers as they are created.

Note: By clicking the **Load** button, you have access to several different preset export layer files.



The Standards button enables you to change the standards also.

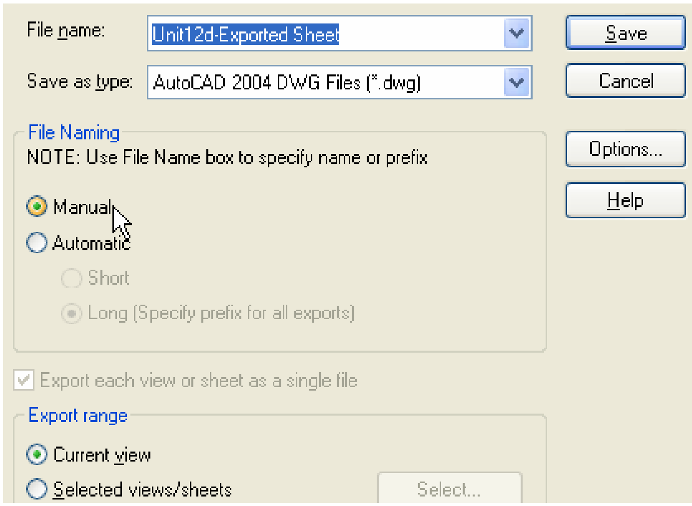




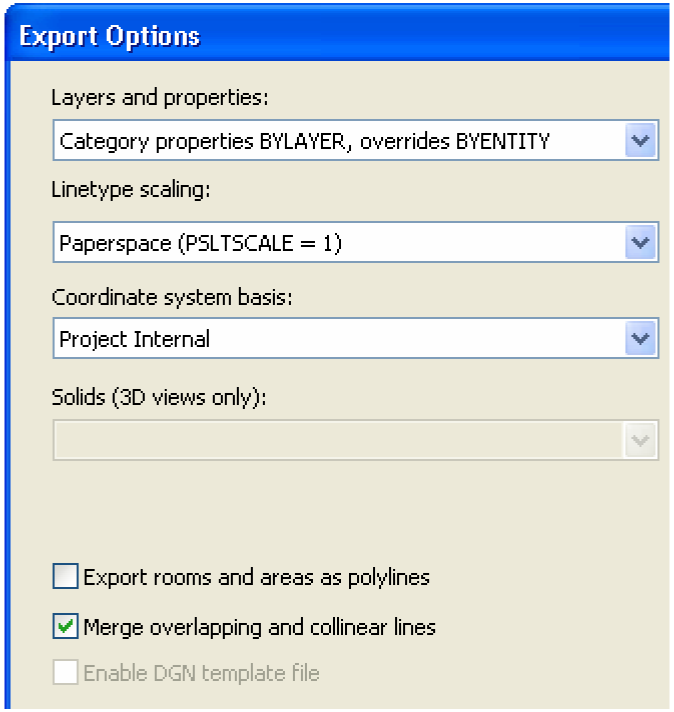
6. Click **OK** to return to the drawing window.

7. From the File menu, choose **Export>CAD Formats**.

8. In the Export dialog box:
   - Select the **Manual** radio button for File Naming.
   - Type in a **file name** for the drawing.
   - Verify that **AutoCAD** is the format to save to.
   - Click the **Options** button.



9. The Export Options dialog box gives you several options as to how the drawing will be created. Verify the settings are as shown, and click OK to return to the Export dialog box.



10. Click the **Save** button to create the new drawing file.

The new drawing is created along with a PCP file for the pen settings that AutoCAD can use to plot this file.

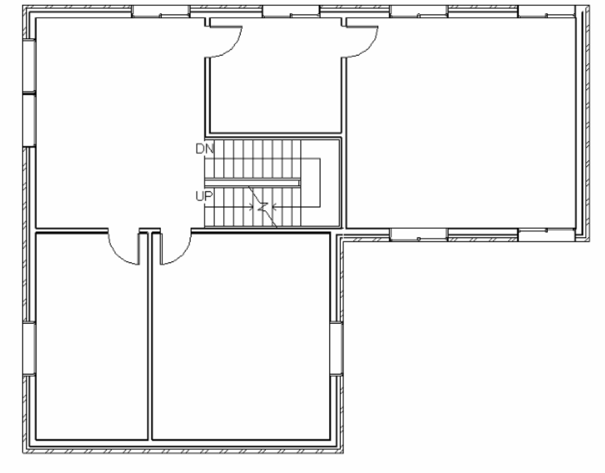
Unit 14

Theory: Detail

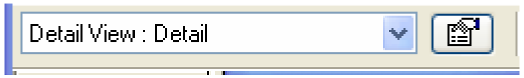
Autodesk Revit Building: Drafting and Linework

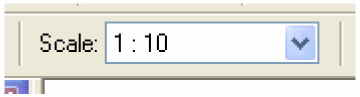
This unit explains how to create detailed drawings using Autodesk Revit Building.

1. Open the file **Unit 14 – Start.rvt** in the training files directory. The project should open up to the view Floor Plans: Level 2.



2. On the Basics Design Bar, click **Section.**
3. On the Options Bar set the following:
   - Section Type = **Detail View**
   - Scale = **1:10**



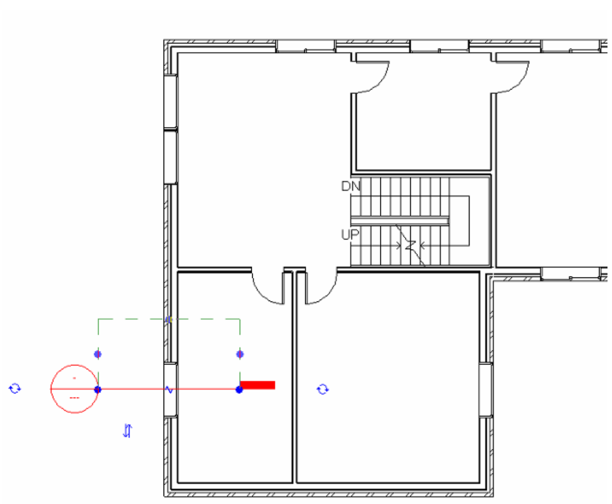


You can create as many section types as you want by duplicating them.

In the Project Browser, details (including sections) appear under the category called Detail Views, while other section types have their own category.

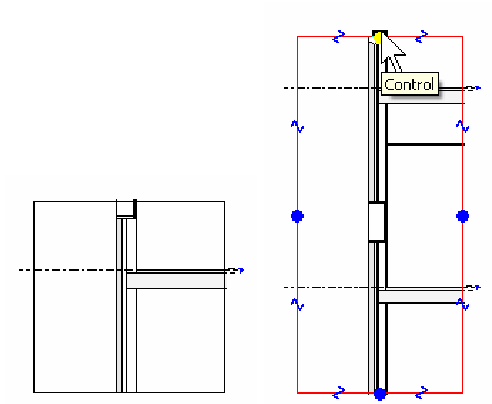
The scale affects the detail level of the newly created view. Normally, all views 1:5 and bigger have detail level set to Fine, but it is possible to change the settings by choosing Detail Level from the Settings menu.

4. Draw a section mark over the window, as shown in image.



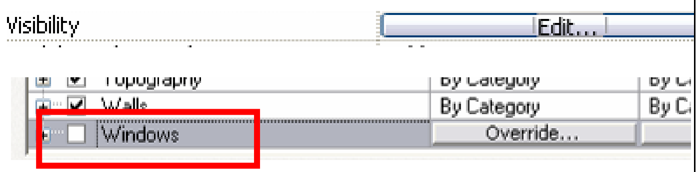
5. Open the section by double-clicking the section bubble or the detail view in the Project Browser.

6. If needed, resize section on top to display Levels 2 and 3, as shown in image.



You may need to resize section views, or maybe even turn off the crop region if it disturbs your drawing: right-click, choose **View Properties**, and clear **Crop Region Visible**.

7. **Right-click** and choose **View Properties** in the section detail view, and under Model Categories turn off visibility of windows.



The keyboard shortcut for displaying the visibility settings for the view is VV. It provides a quick way to jump directly to the dialog box.

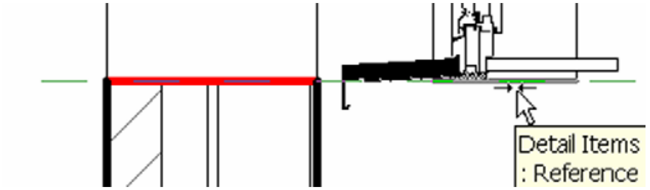
8. Click **OK** to exit dialog box. Click **OK** again to close view properties.

9. From the File menu, choose **Load from Library>Load Family**. Navigate to the **Workbook Data set\Extra rfa files** and select the file called **Window Section.rfa**. This detail component was generated from a DWG file.

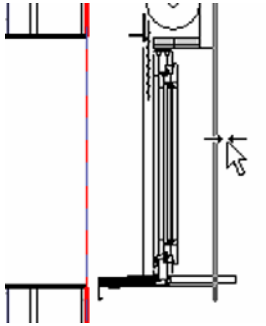
Detail components can be created by drawing directly or by importing a DWG, DXF™, or DGN file if you already have the detail in one of these file formats.

10. On the Drafting Design Bar select **Detail Component**. The loaded Window section detail component should be ready to be placed on the drawing.

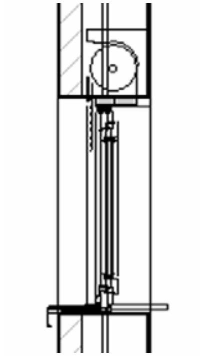
11. Place the window detail component as shown in image. Use the **Align** tool to help align it correctly to the sill and the wall finish.



Align sill to bottom of window opening.

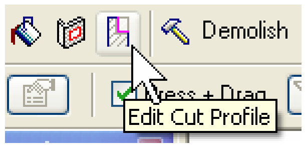


Align interior face to interior face.

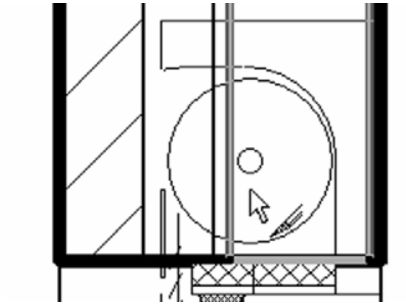


Edit Cut Profile

12. Click the **Edit Cut Profile** icon on the toolbar.

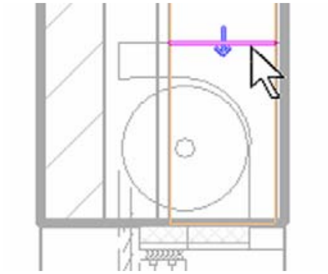


13. Click the hatch or boundary of the subcomponent you want to modify.

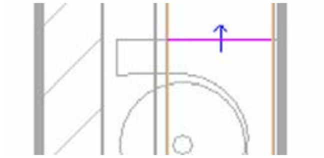


This takes you into sketch mode, where you draw the linework for the new cut profile of the component.

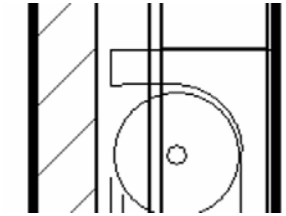
14. Use the **Lines** tool to draw a new profile where you want the subcomponent to be cut.



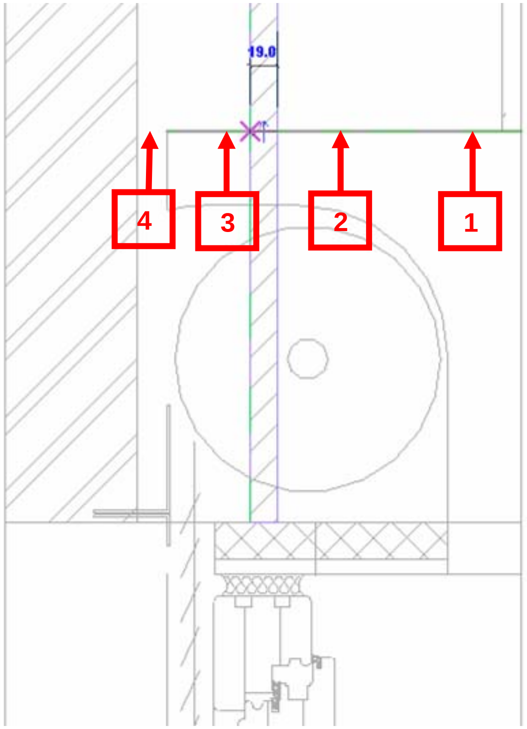
15. Click the blue arrow toward the side you want to keep.



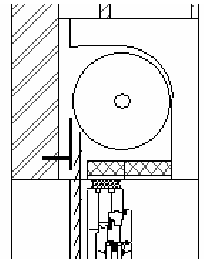
16. Click **Finish Sketch**.



17. Repeat the process with all four wall components underneath the window detail component.



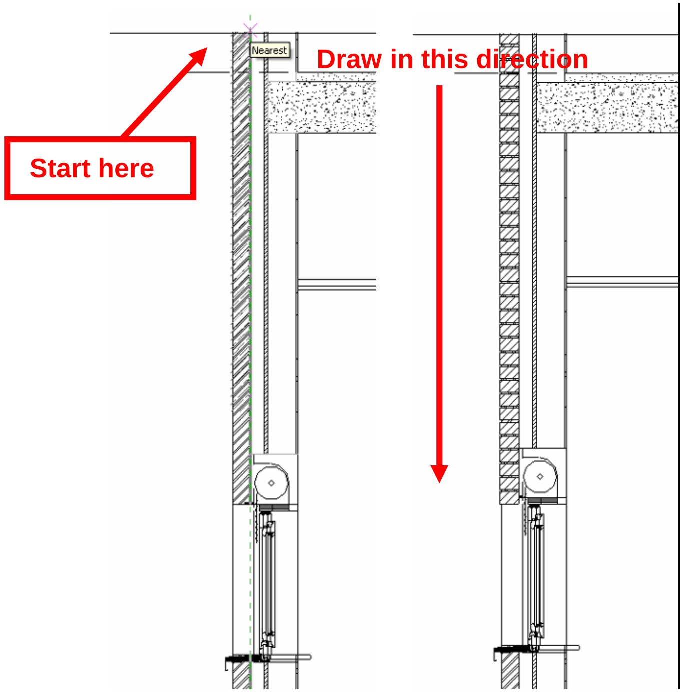
The profile of each material must be edited separately because the tool works on one hatch at a time.



18. On the Drafting Design Bar, click **Repeating Detail,** and on the Options Bar, click **Brick – Section**.

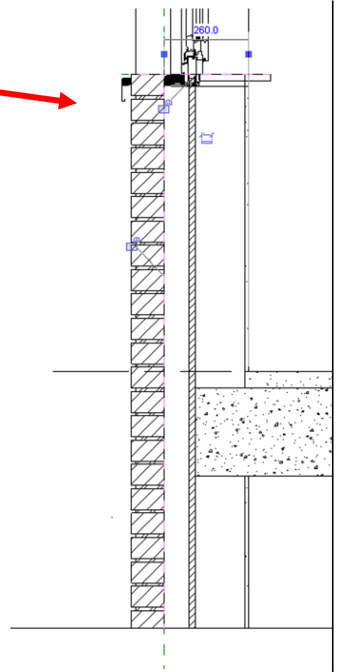
Use detail components in arrays to create a repeating detail, or you can use the repeating detail tool. A simple example is a series of bricks in section view. There are various ways to assemble the detail component in a repeating detail.

19. Draw a line on the exterior part of the wall, as shown in image. Don't worry about correct positioning. Move it into the correct position after placing it.



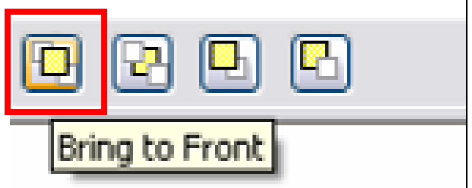
Use the Align tool to move a repeating detail into position.

20. Add another **Brick – Section** repeating detail below the window.



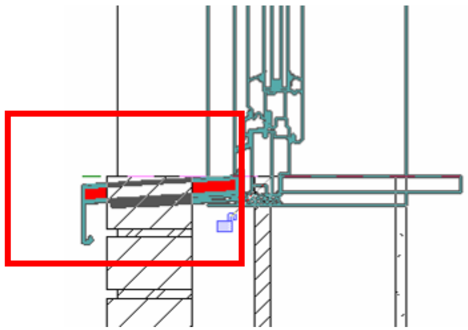
Note that this brick detail component contains an invisible line that defines the width of the mortar. You could add a hatch in the detail component so it displays the mortar in the repeating detail.

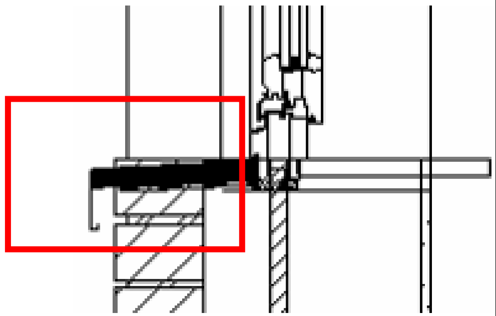
21. If the brick repeating detail is in front of the window detail, select the former and on the Options Bar click the **Bring to Front** icon.



Annotations and detail components are view specific: they are visible only in the view they were created in.

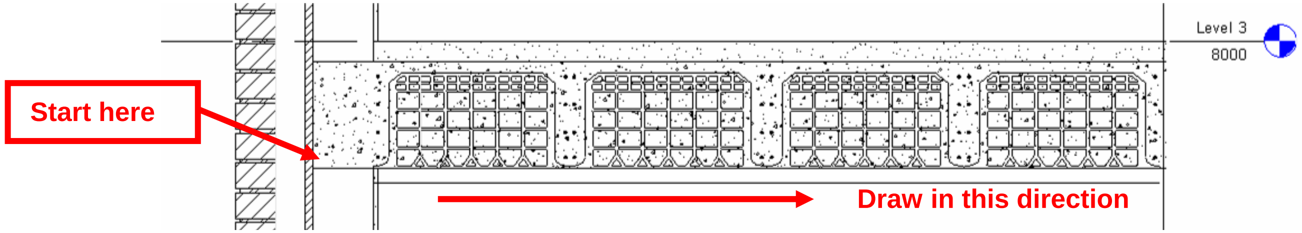
It is possible to define the order of their appearance by using the toolbar displayed on the left. This toolbar appears on the Options Bar once a detail component has been selected.





22. On the drafting Design Bar, select **Repeating Detail: Concrete-Masonry Slab – Section 500mm**.

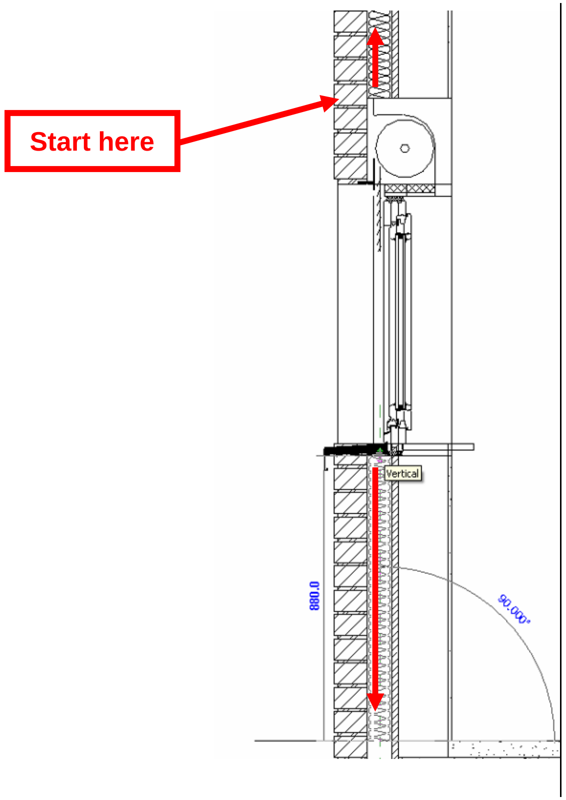
23. Draw the repeating detail as shown in the image: from the left intersection with the wall toward the right.



The hatch of the underlying floor slab should not be visible in the detail component. You can edit its cut profile as you did with walls, but it would be more convenient to add some hatches directly in the detail component to hide whatever lies beneath.

24. On the Drafting Design Bar, click **Insulation**, and set the size on the Options Bar to **70mm**.

25. Draw the insulation in the exterior wall, as shown in image, both above and below the window detail.



Change the insulation width after designing it by right-clicking it and choosing Properties>Width Field, or simply by changing the Width value on the Options Bar.

Unit 16

Theory: Is Architecture Engineering?

Autodesk Revit Building: Formulas

This exercise starts with a data set that is a window family. The window family is already complete; you add some formulas to control the geometry and visibility of some of the solid elements that compose the window family. In particular, you create

- Formulas that control the relative height of the frames (and the glass) depending on the sill thickness
- A formula that controls visibility of the crown, to be displayed only if the window width is equal to or larger than 1400mm'

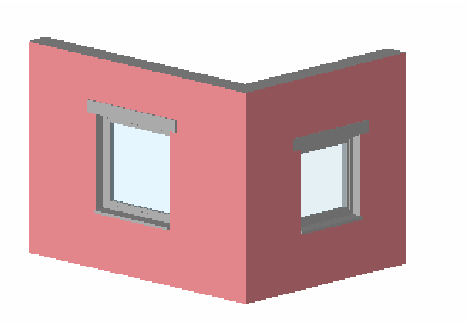
Parameter values should always be changed in the Family Types window to verify if the model flexes correctly.

In Unit 11 you added formula parameters to control the width of the drawer of the shelf unit. You also added a visibility parameter.
In this exercise you create fomulas and tie the display of the crown or lintel of the window to the result of the formula.

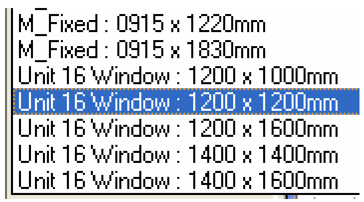
This exercise assumes you have worked through the exercises in Units 10 and 11. If you have questions about terminology or processes, you can go back to those exercises for review.

Explore the Window Family in the Project

1. Open file **Unit – 16 – Start.rvt**.
2. Set current 3D Views: {3D}.



3. Click the window in the view.
4. Note that there are already a few types inside the family. Select them from the drop-down menu. Return to the type named 1200 x1200mm.



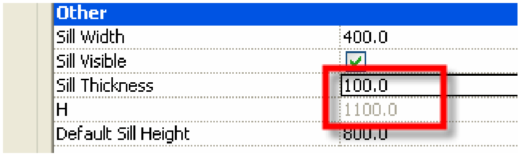
In this section you explore the existing parameters set up in the window family.

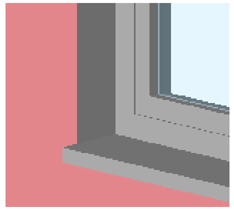
The window family is already complete, but you will add formulas to control the geometry and visibility of some of the solid elements that compose the window family. In particular, you create formulas that control the relative height of the frames (and the glass), depending on the sill thickness and whether it is visible. Another formula controls visibility of the crown, to be displayed only if the window width is equal to or larger than 1400mm.

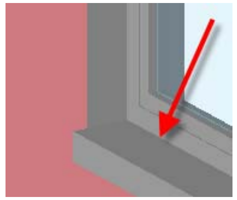
5. Open the type parameters for the 1200 x 1200mm window type.

6. Change the sill thickness to 100.

7. Click the **Apply** button.



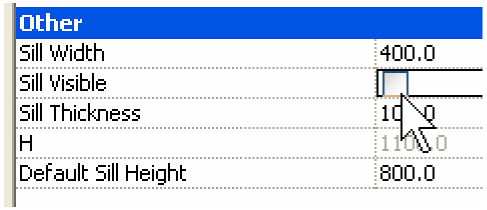

with Sill Thickness = 40

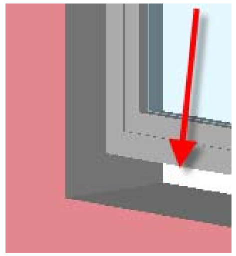

with Sill Thickness = 100

Note when you do this, the H parameter changes as well. The current definition of the H parameter is height (of the window opening) less the sill thickness.

8. In the Type Properties for the window, clear **Sill Visible**.

9. Click OK to return to the drawing window.



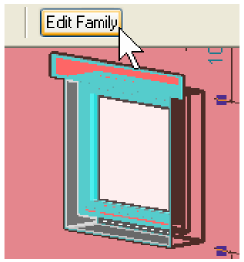

The window has a gap where the sill is still taken into consideration, but is not displayed.

Edit the Window Family

10. Click the window.

11. On the Options Bar, click **Edit Family**.

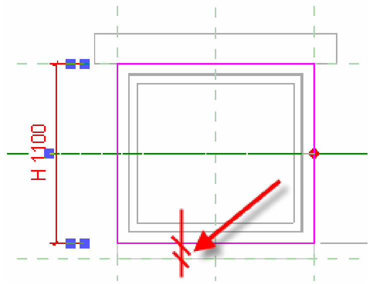
12. Click **Yes** to edit the family.



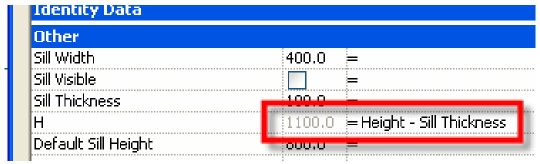
You add a formula to control the relative frame height according to the sill visibility.

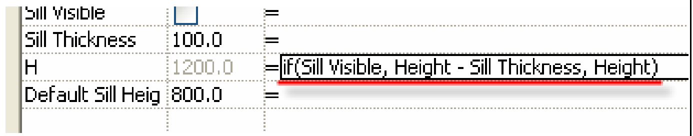
Formulate the H Parameter

The H parameter was specifically created and assigned to the frame height. To see how it is defined, select the outer frame and click Edit on the Options Bar. Click Sketch 2D Path on the Design Bar, and go to exterior elevation view. Note the gap from the bottom of the sketch line to allow for the sill.



13. In the Family Types dialog box, click the **H** Parameter row, and under the **Formulas** column replace the formula Height-Sill Height with the IF formula: **if (Sill Visible, Height - Sill Thickness, Height)**.





The formula syntax is:

IF (<condition>, <result-if-true>, <result-if-false>)

Because Sill Visible is a Yes/No parameter, you only need to type the condition by itself.

Formulas and parameters are case sensitive.

To put this into plain English:

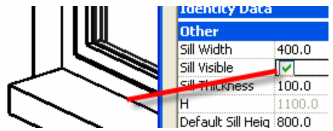
If the sill is visible (condition is true), then **Height - Sill Thickness** (raise the frame for the sill).

If the sill is not visible (condition false), then use the value held by the Height parameter as the height of the window, filling in the space that would otherwise be occupied by the sill.

14. Click **Apply**. Change the Sill Thickness parameter to different values, and click **Apply** each time you change the value. Note how the height of the window frame now changes correctly.

Always flex your family from the Family Types dialog box to make sure the model responds correctly.

15. Clear the **Sill Visible** parameter, and click **Apply**. Note how the frame resizes accordingly to fit precisely in the opening.

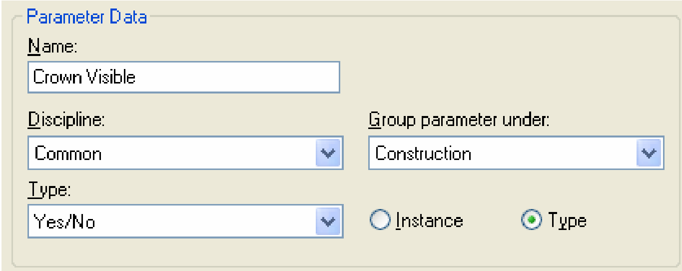


Note that the sill is still visible in the model but is dimmed. In the Family Editor even if visibility of a specific component is turned off, you still see it for editing purposes. In the normal project environment, the sill would not be visible.

Create Crown Visibility Parameter

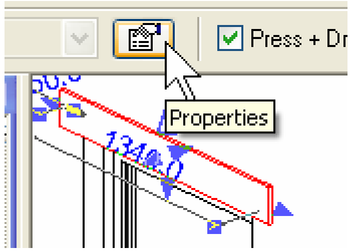
In the last section you controlled a length parameter by the visibility Yes/No parameter. In this section you do the opposite and control a visibility parameter based on a length. If the window width is greater than a specified width, show the Crown/Header. If it is less than the specified width, do not show it.

16. You next create a visibility parameter to control the crown visibility. Click the **Add** button under the Parameters category in the Family Types dialog box.
17. Create a new **Yes/No** parameter called **Crown Visible** (see image on the right). Click **OK** to return to the Family Types dialog box and click **OK** again to close the dialog box.



You can create different types of parameters, by opening the Type drop-down menu to see them all.

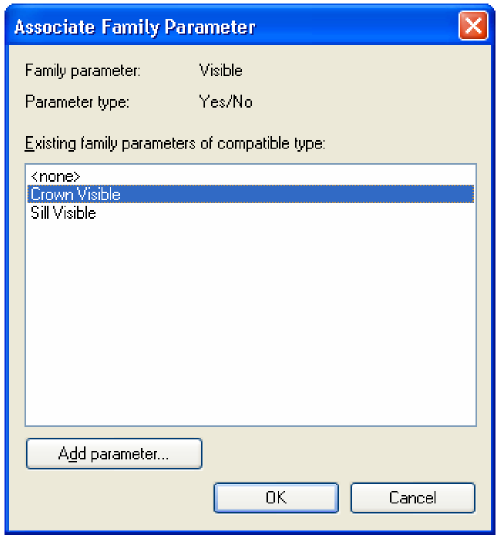
18. Select the solid that acts as the crown and open its Properties dialog box by **right-clicking Properties** or by clicking the Properties icon on the Options Bar.



19. Click the gray icon displaying the ellipsis (…) under the Visible row of its properties.

Clicking the button enables you to assign control of that element parameter to an equivalent family parameter that can then be either used in formulas or changed directly in the project.

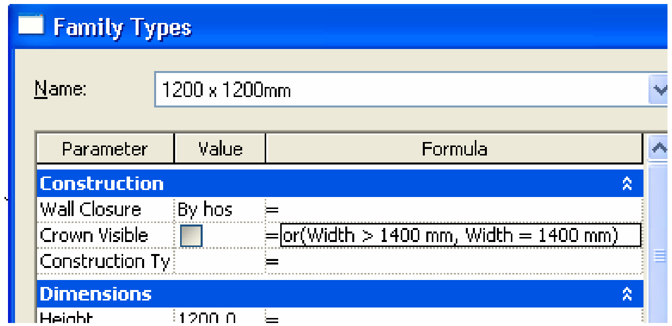
20. Assign it the **Crown Visibility** parameter, which you created in the previous step.



The family parameters displayed are only those of the same type: length parameter if you are setting a distance, Yes/No if you are selecting a visibility parameter, material if you are assigning a material parameter, and so on.

21. Click **OK** twice to close the dialog boxes.
22. Open the Family Types dialog box, and under the **Crown Visible** parameter row enter the formula:

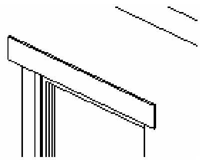
    or(Width>1400mm, Width=1400mm)



Formulas are case sensitive.

It's a good idea to type the unit suffix in formulas directly to avoid confusion.

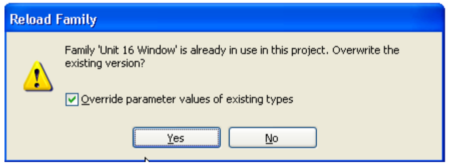
23. Change the window type from the active one to **1400 x 1400mm** and note the changes in the Crown Visibility.



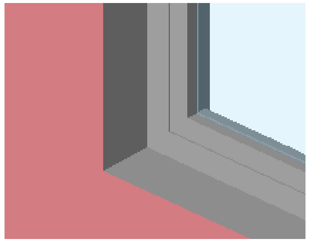
24. On the Design Bar, click **Load into Projects**.

If you have more than one project open, you see an additional dialog box to select which projects to load the family into. Select the Unit 16 – Start project.

25. Select the check box to override parameter values of existing types.
26. Click Yes.

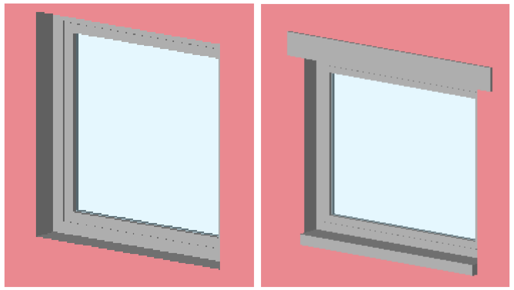


27. Flex the family in the project.
28. Turn off the sill in type properties.



The frame now fills in the full height when the sill is turned off.

29. Change the window to different types.



30. Use the Window menu to change back to the window family.
31. Close without saving the family.

The family is already loaded into the project. You can save it as a different family or just close it without saving.

Unit 17

Databases

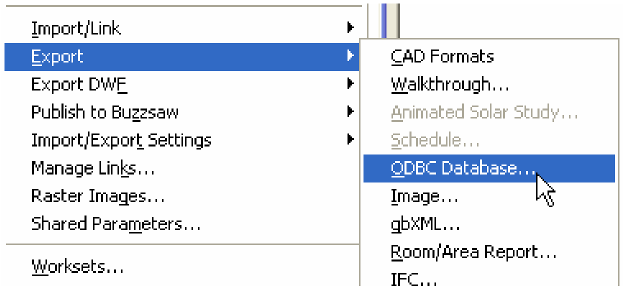
In this exercise you export a Revit Building project to an ODBC-compliant database.

There is no data set provided for this exercise.

Export a Database

1. Open a project. If you are not working on your own project, just open one of the projects provided with the workbook.

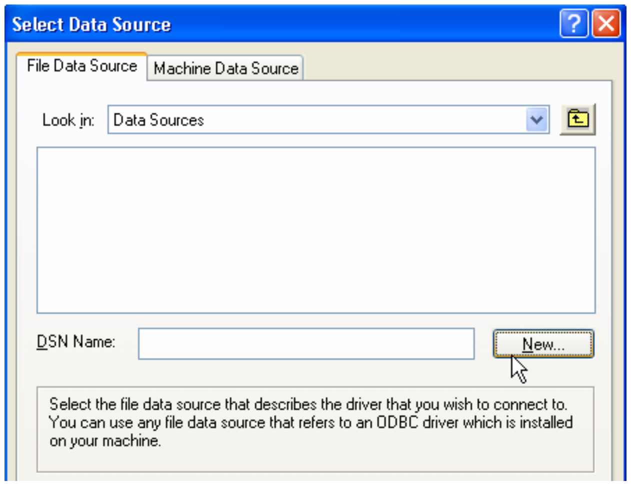
2. From the File menu, choose **Export ODBC Database**.



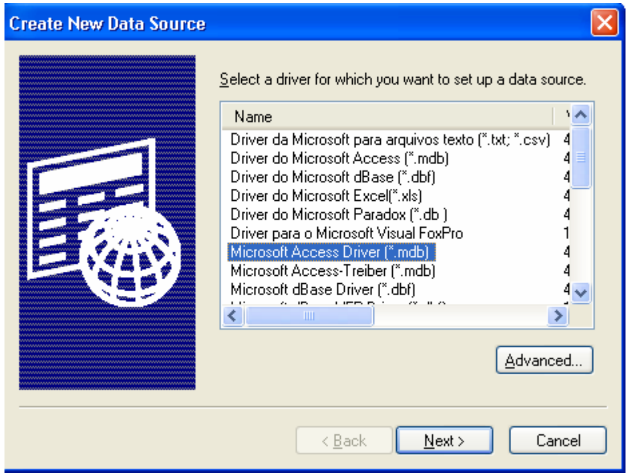
ODBC stands for Open DataBase Connectivity. The purpose of this is to create a database that can be used by any database management system regardless of the application. Part of an ODBC-compliant database is a data source name file. This file is like a translator to the database and provides a link between the database and the software used to interpret the data.

In this exercise, you create both an access database (MDB) file and the data source name file.

3. In the Select Data Source dialog box, click the **New** button.

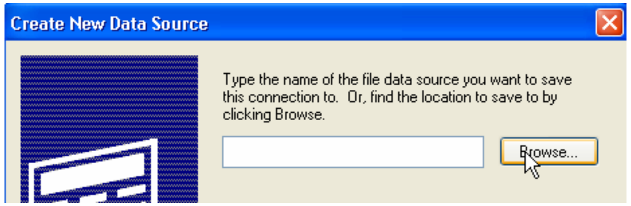


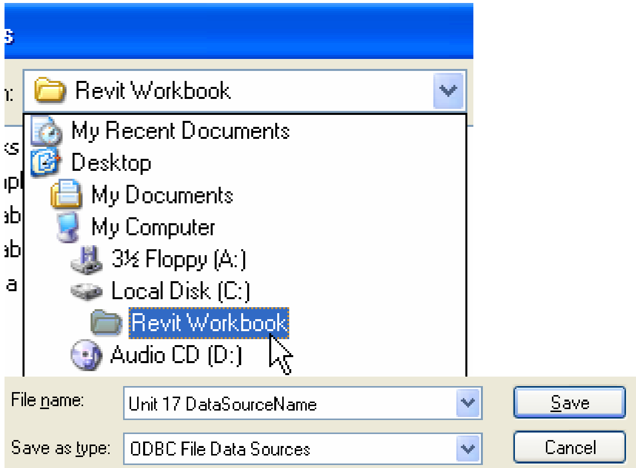
4. Click the **Microsoft Access Driver** and then click the **Next** button.

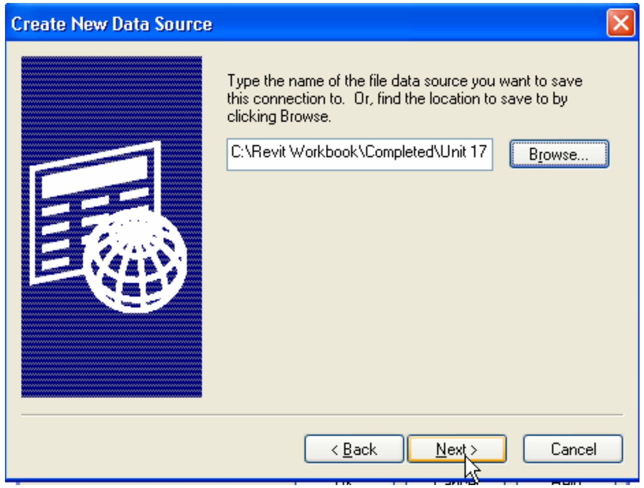


5. In the Create New Data Source dialog box:

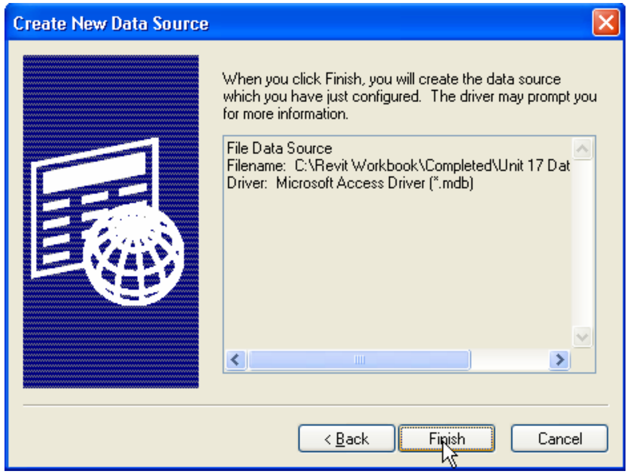
   a. Click the **Browse** button.
   b. Browse to the workbook's data set folder.
   c. Name the file.
   d. Click the **Save** button.
   e. Click the **Next** button.



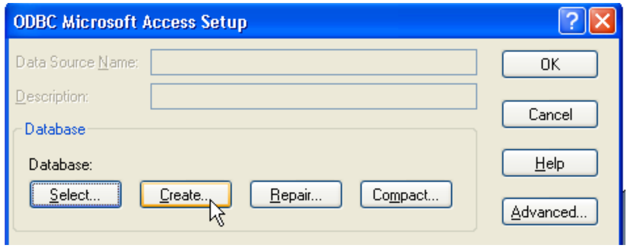




6. Click the **Finish** button.

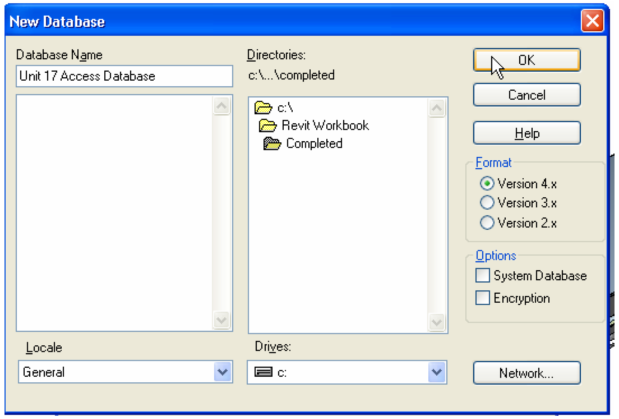


7. In the ODBC Microsoft Access Setup dialog box, click the **Create** button.

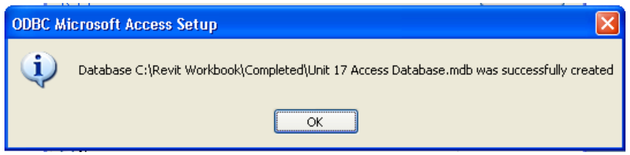


8. Enter a name for the database and verify the location were you want to create the database.

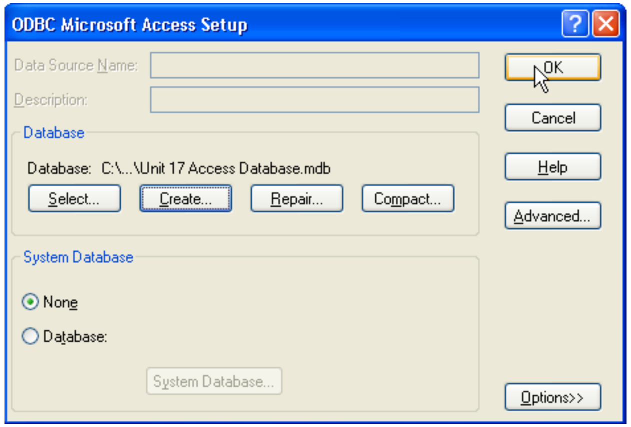
9. Click **OK**.



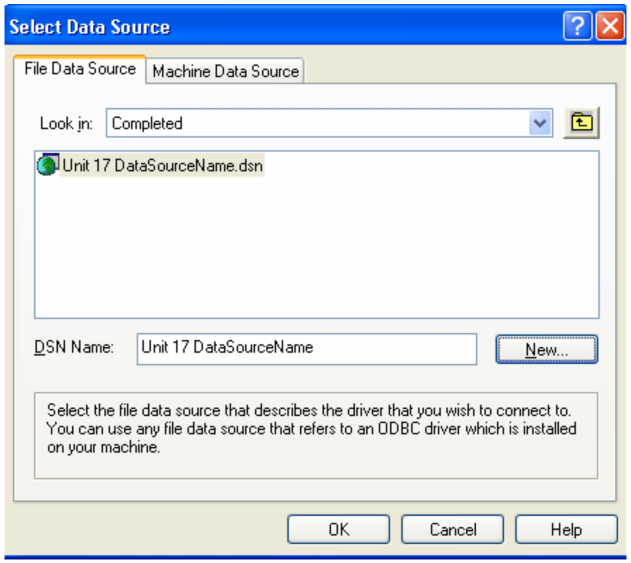
10. Click **OK** again.



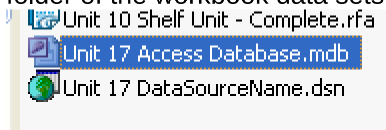
11. Click **OK** again.



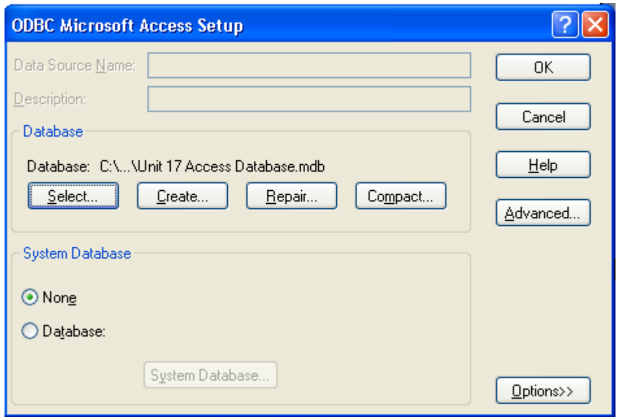
12. Click **OK** again.



The database has been created in the folder you specified. This sample is provided in the Completed folder of the workbook data sets.



13. Click **OK** again.



Unit 18

Theory: Schedules, Tables and Legends

Schedules are just another view of the building model, but instead of representing the data in a graphical format, the information in the building database is presented in tabular format.

Autodesk Revit Building: Tags and Schedules

The seven exercises in this unit cover the scheduling capabilities of Autodesk Revit Building. Each covers a different aspect of schedules in the Revit Building environemt.

- 18a: Door schedules
- 18b: Room objects schedule and tags
- 18c: Calculated values in a room schedule
- 18d: Room finish keys
- 18e: Color fill legends
- 18f: Symbol legends
- 18g: Material takeoff schedules

Unit 18, Exercise A: Door Schedules

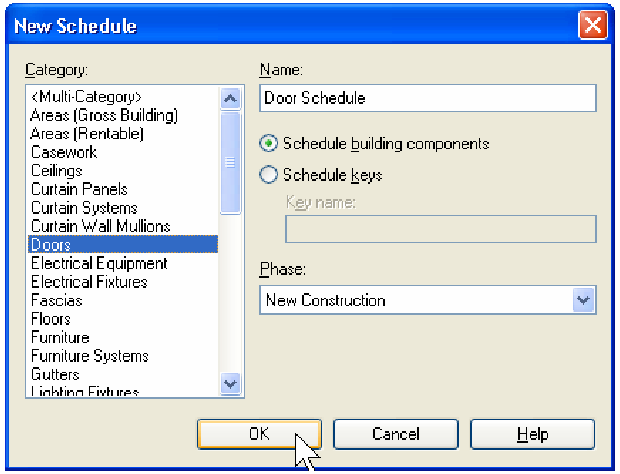
In this exercise you create a door schedule, modify its properties, and place it on a sheet.

1. From the **File** menu, choose **Open**. Browse to the file **Unit 18a – Start** delivered with the workbook and open it.

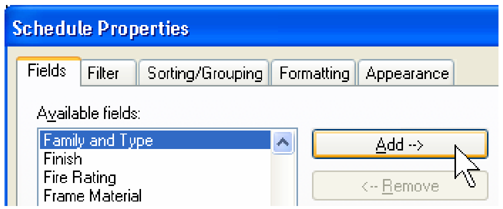
The file opens with a 3D view of the building. The active view doesn't have an effect on the creation of the schedule table. You can make a schedule table of any object having any view of the model. There are two ways to make a schedule table: using the Schedule button on the View Design Bar or by choosing: New>Schedule Table from the View menu.

2. On the Design Bar, click **Views** and then **Schedule/Quantity.**

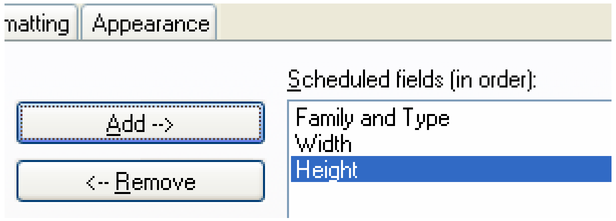
3. From the **Category** list, select **Doors** and click **OK**.



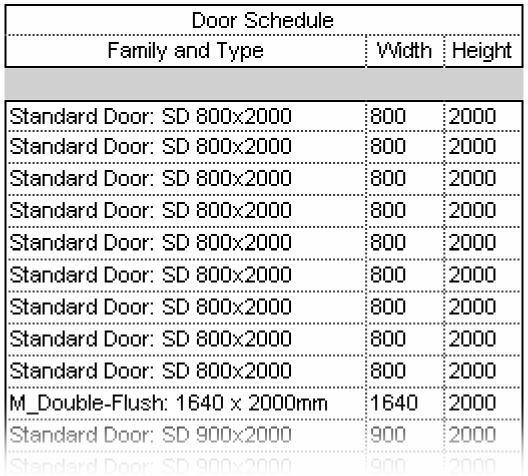
4. In the **Schedule Properties** dialog box under Available Fields, click **Family and Type** and then click **Add**.



The Family and Type field is now moved to the right, under Scheduled Fields. This will now be one of the columns in the schedule. Repeat for two other fields: **Width** and **Height**.

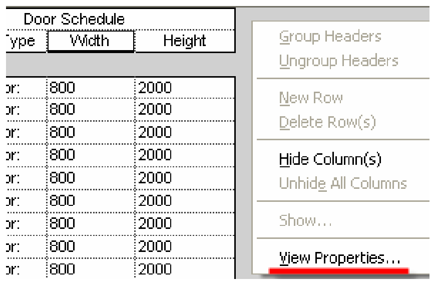


5. Click OK to close the Schedule dialog box.



Door Schedule		
Family and Type	Width	Height
Standard Door: SD 800x2000	800	2000
Standard Door: SD 800x2000	800	2000
Standard Door: SD 800x2000	800	2000
Standard Door: SD 800x2000	800	2000
Standard Door: SD 800x2000	800	2000
Standard Door: SD 800x2000	800	2000
Standard Door: SD 800x2000	800	2000
Standard Door: SD 800x2000	800	2000
Standard Door: SD 800x2000	800	2000
M_Double-Flush: 1640 x 2000mm	1640	2000
Standard Door: SD 900x2000	900	2000

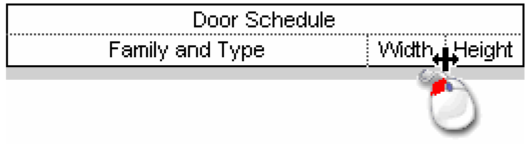
6. Right-click over the schedule table. From the context-sensitive menu, choose **View Properties**.



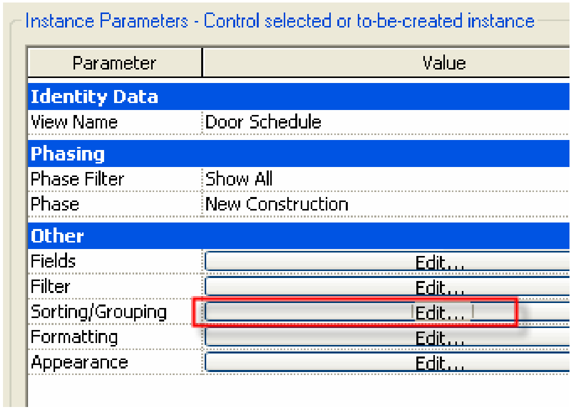
The Available Fields list contains all information that can be extracted from the door object. On the right is an empty list in which you are going to add the information that you want to see displayed in the schedule table.

The schedule table is displayed in table form. The order of the fields determines the order of the columns in the schedule table. You can easily modify this using the Move Up and Move Down buttons.

You can change the appearance of your schedule table by adjusting the width of the columns. The principle is simple: just drag the separation line between two columns in the title to the desired width.



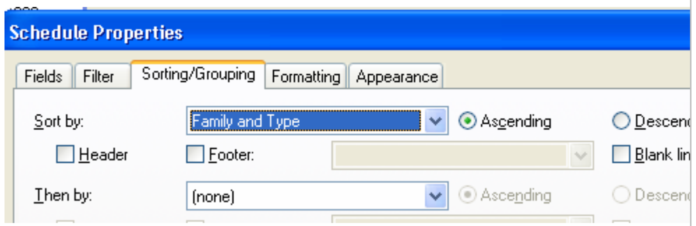
7. In the **Element Properties** dialog box, click the **Edit** button next to **Sorting/Grouping**.



8. In the newly opened dialog box, under Sort By, select **Family and Type**.

9. Click **OK** to close the Schedule Properties dialog box.

10. Click **OK** to close the Element Properties dialog box.



The schedule table displays correctly according to the sorting criteria you have defined. Autodesk Revit Building allows four levels of sorting.

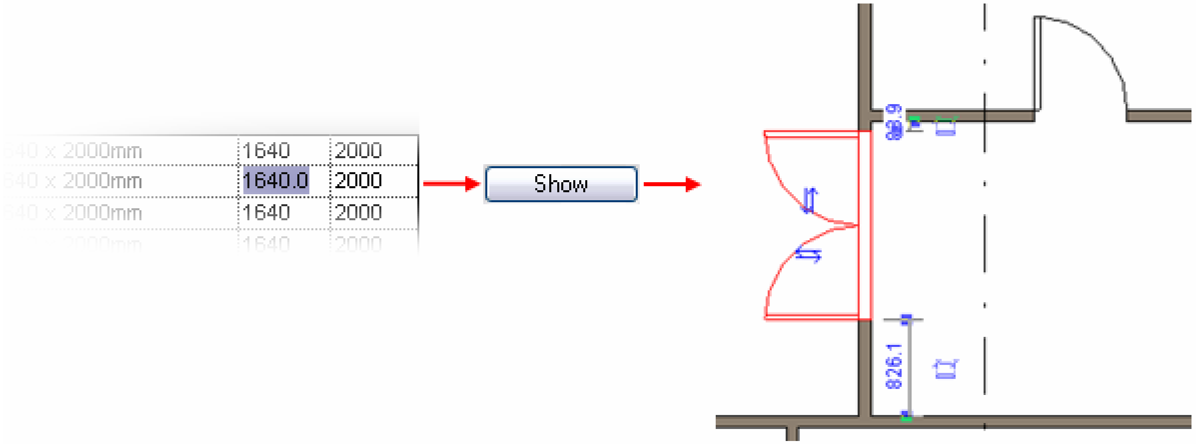
Every line in the schedule table represents a door within the project. You might think this is an odd way to represent a door, but Revit Building can represent an object in a textual manner, showing all important information about that object.

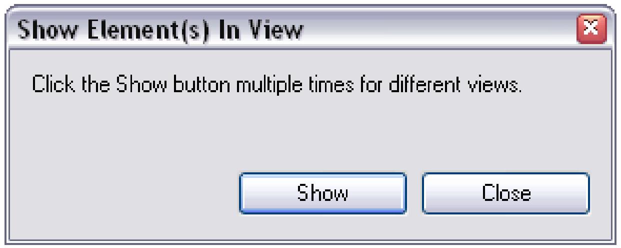
Before you continue working on your door schedule, you need to analyze the possibilities that Autodesk Revit Building proposes at this stage. Let's look at the Options Bar.

11. Click in any schedule table field, and then click the **Show** button.

12. You can achieve the same by right-clicking the schedule field, and choosing Show.

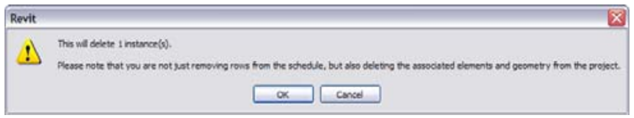
13. Revit Building opens a view in which you see a graphical representation of the selected door.





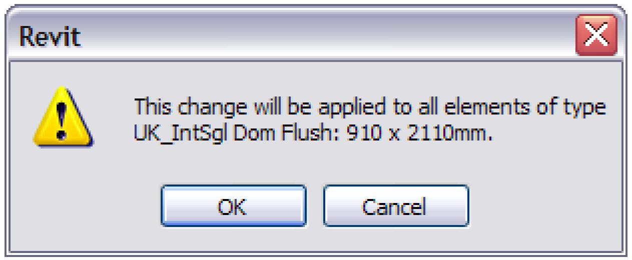
Autodesk Revit Building enables you to search for other views in which this door is displayed. To do that, click the Show button. Should you not want to continue, simply click the Close button.

14. Click again in any schedule table field, and on the Options Bar, click **Delete**.

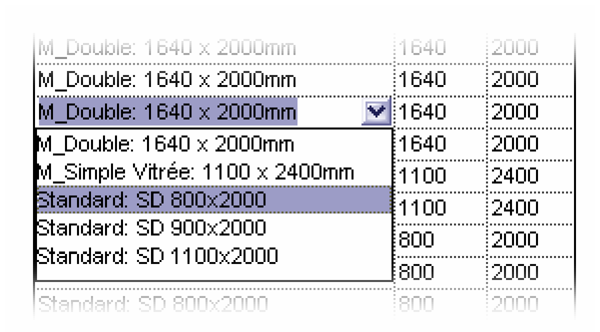


Autodesk Revit Building double-checks that you really want to delete that instance so you have a final choice of accepting (OK) or Cancel.

Again, you can find the same command by right-clicking and using the context-sensitive menu.



Notice that the schedule table cells are editable. You can change any value in the schedule table (for example, the width of the door). You should be careful when doing that however, because the door width is a type parameter, which means you would change the width of all instances of this type in the project.



Finally, you can change the family and type by simply clicking the family and type field. This field contains a pull-down list from which you can select the desired door family or type.

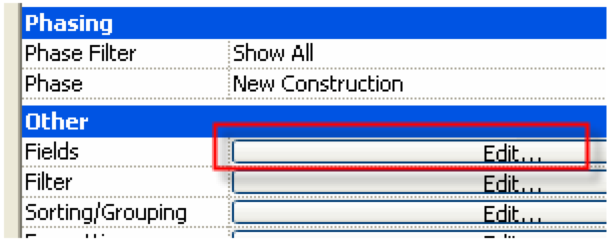
What is important to understand here is that no matter what changes you undertake in the schedule table, they are populated everywhere in the project. The opposite works as well. If, for example, you delete or add a door in the project, the door is automatically deleted or added in the schedule table. In the Revit Building model, the schedule tables are always directionally synchronized with the project.

You are now going to work further on your schedule table, refine it, add new fields, sort it, modify its parameters, and finally place it on a layout sheet.

15. **Right-click** over the schedule table.

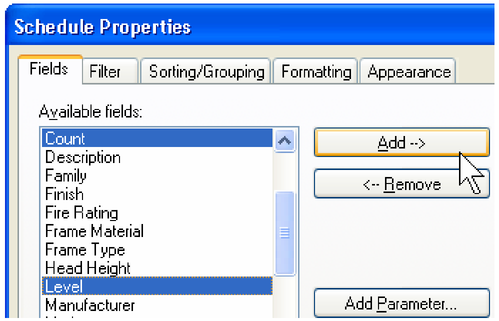
16. From the context-sensitive menu, choose **View Properties**.

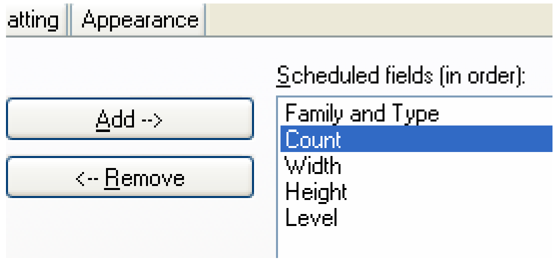
17. In the **Element Properties** dialog box, click **Edit** next to **Fields.**



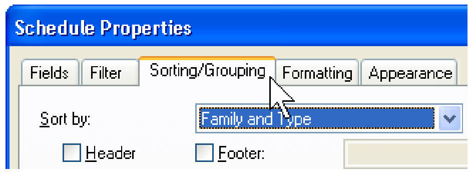
You have now set all necessary fields. Next you sort your schedule table to make it more usable. Revit Building lets you sort with four different criteria simultaneously. Here, you want to sort by level and then by family and type.

18. Add the fields **Count** and **Level,** reorganize them as shown in the image using the **Move Up** and **Move Down** buttons.



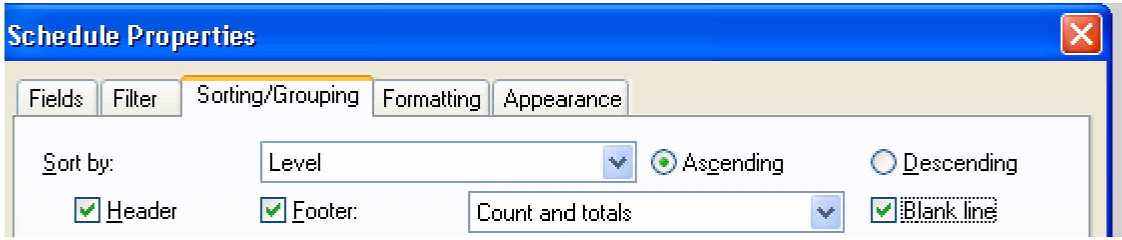


19. Click the **Sorting/Grouping** tab.

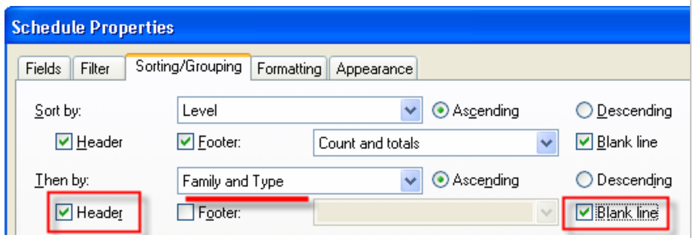


On the Sorting/Grouping tab you find the criteria set previously. You need to change them. You want to sort this time by level and then family and type. As there are two criteria for sorting, you need to intervene on the Header and Footer.

20. On the **Sorting/Grouping** tab set the following:
21. Under **Sort by** select **Level**.
22. Select the **Header and Footer** check boxes, and in the list next to Footer, select Count and Totals. Also select the Blank Line check box.



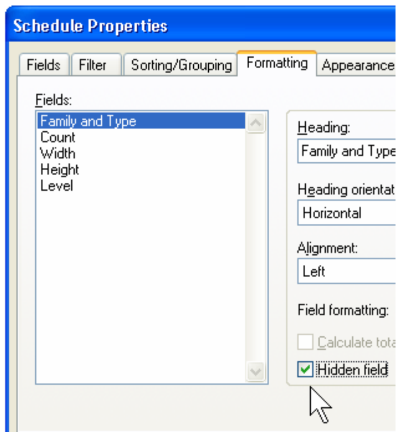
23. In the Then By field, select **Family and Type**.
24. Select the Header and Blank Line check boxes.
25. Click **OK** to close all dialog boxes.

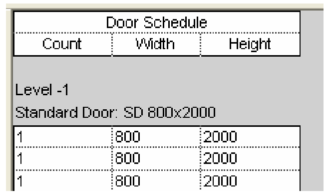


As a result of the criteria you defined, you find doubling parameters. For example, you can see the Header M_Double: 1640 x 2000mm in every row of the door, but it's the same for the level as well. This isn't a problem, because Revit Building lets you hide fields you don't want to be visible.

26. Right-click over the schedule table.
27. Go to **View Properties**.
28. In the **Element Properties** dialog box, click **Edit** in the **Formatting** field.

29. Verify that the selected field is **Family and Type.**
30. Select the **Hidden Field** check box at the bottom of the dialog box.
31. Click **OK** to close all dialog boxes**.**





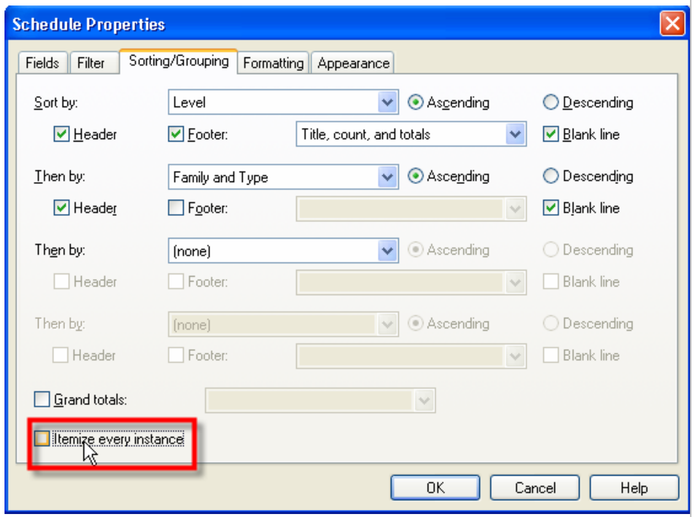
As you can see, those fields are not displayed. However, notice that the schedule table displays every instance of your doors, but you need to know the total number of doors of the same type. So, you need to fix that final problem.

32. Right-click anywhere over the schedule table again.
33. Select **View Properties**.

Should you need it, you can also display the total number of doors in your building. To make that visible, you need to select the Grand Totals check box on the Sorting/Grouping tab.

34. In the **Element Properties** dialog box, click the **Edit** button next to **Sorting/Grouping.**

35. Clear the **Itemize Every Instance** check box.
36. Click **OK** to close all dialog boxes.

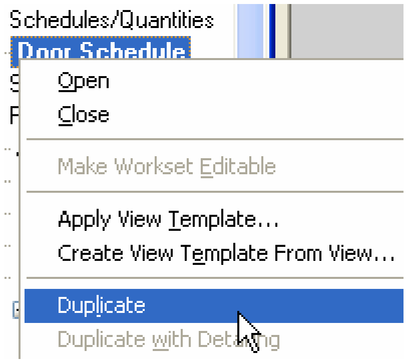


Duplicate the View

For the moment, you can consider your schedule table ready. However, you haven't yet learned about schedule filters. The filters allow you to filter through the data in the schedule tables. As for sorting/grouping, there are four levels of filtering. You can filter only fields that are already present on the Fields tab.

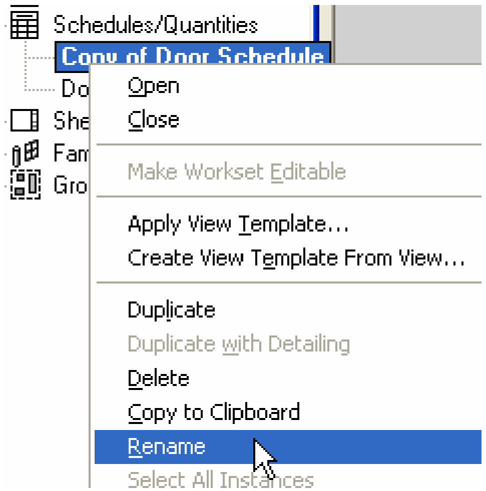
Next, you duplicate the schedule table view and apply a filter to the duplicated view. The goal is to have a schedule table that shows only the doors on Level 2. You reuse the schedule table in the second part of the exercise (Create a Room Schedule Table).

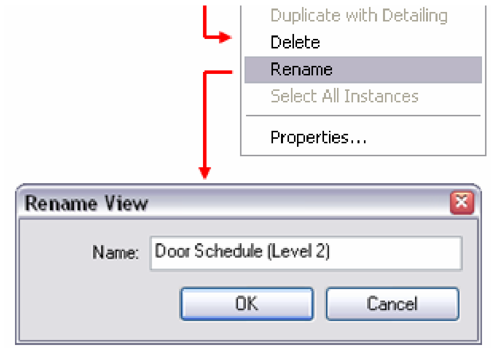
37. In the **Project Browser**, scroll to the **door schedule** and right-click it. From the context-sensitive menu, choose **Duplicate.**



38. **Right-click** the **Copy of Door Schedule**, and choose **Rename** from the context-sensitive menu.

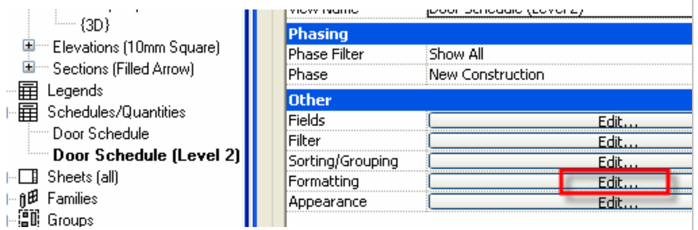
39. Change the Name to **Door Schedule (Level 2)** and click **OK**.





40. Right-click the **Door Schedule (Level 2)** schedule table and choose **Properties.**

41. In the **Element Properties** dialog box, click the **Edit** button next to **Fields.**



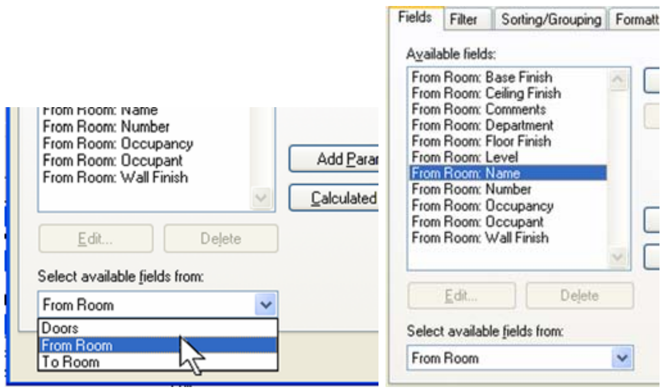
42. In the **Schedule Table Properties** dialog box, set the following:
43. Using the **Remove** button, delete the **Count** field**.**

44. Using the Select Available Fields From drop-down menu, click **From Room**.

45. Under Available Fields, click **From Room Name**.

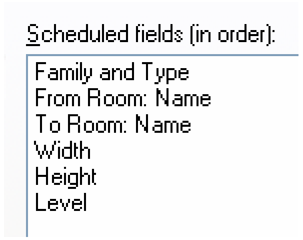
46. Click the **Add** button.

47. Repeat to add **To Room: Name**.



You can just as easily insert or delete fields from the schedule table by double-clicking the desired field.

48. Again, arrange the list of fields as shown on the right using the Move Up and Move Down buttons.



49. In the **Schedule Properties** dialog box, click the **Filter** tab.

50. In the **Filter By** list, select **Level**.

51. In the next field select **Equals** and set **Level 2** in the next field below Filter By.

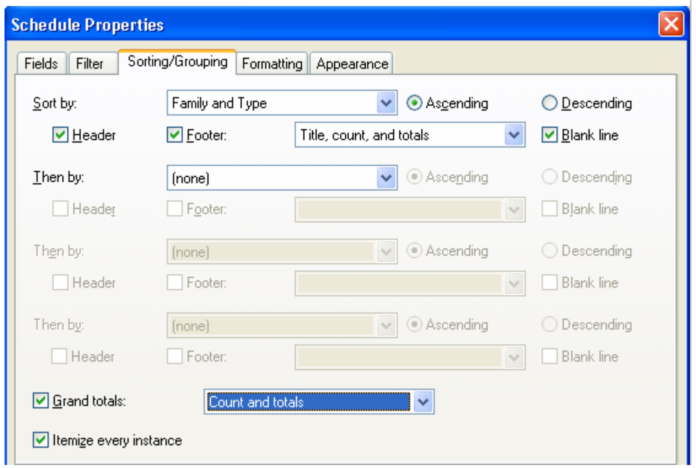
52. Click the **Sorting/Grouping** tab.

53. Verify that Sort By shows Family and Type.

54. Verify that **Header, Footer,** and **Count and Totals** are selected.

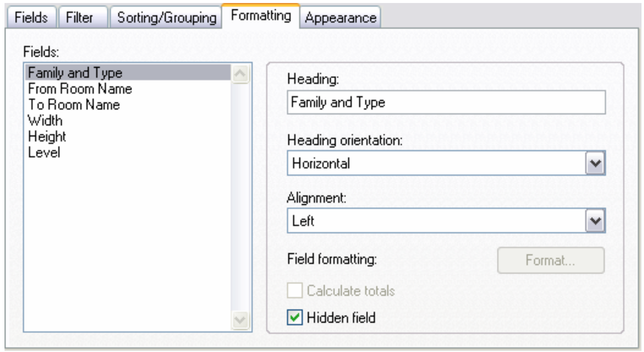
55. Verify that the Then By sorting line is set to **None**.

56. Select Blank Line, and at the bottom of the dialog box select **Itemize Every Instance**.

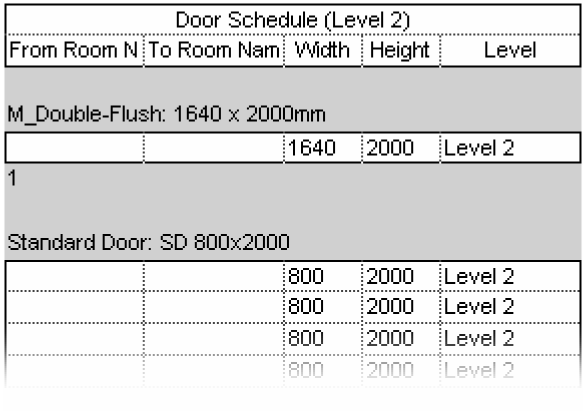


57. Click the **Formatting** tab.

58. Verify that **Family and Type** is the active field, and select **Hidden Field**.



59. Click **OK** twice to close all dialog boxes.

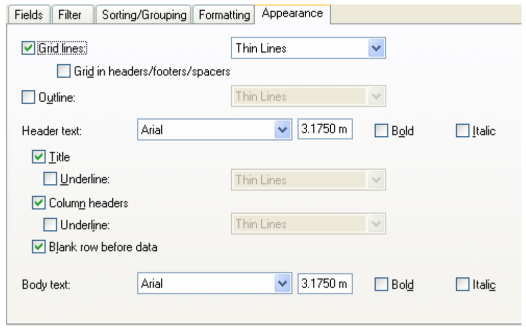


Door Schedule (Level 2)				
From Room N	To Room Nam	Width	Height	Level
M_Double-Flush: 1640 x 2000mm				
		1640	2000	Level 2
1				
Standard Door: SD 800x2000				
		800	2000	Level 2
		800	2000	Level 2
		800	2000	Level 2
		800	2000	Level 2

Here you have the schedule table displaying the new criteria you have just defined. For the moment the two new parameter fields (From Room Name to Room Number) are empty. The software automatically fills them in the moment you define the rooms themselves (in other words, when you add a room tag in the room, which is what you do in the second exercise in this unit).

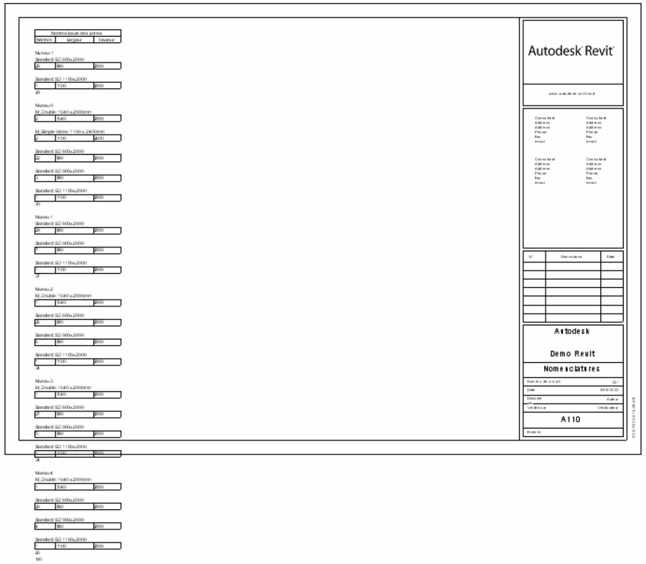
Create New Sheet for Door Schedule

Certain parameters of the schedule tables are only visible once a schedule table has been placed on a sheet. That's the case with parameters on the Appearance tab of the Schedule Table Properties dialog box. You are now going to study the placement possibilities of a schedule table on a sheet. For that purpose, you use the entire schedule table of all doors in this building.



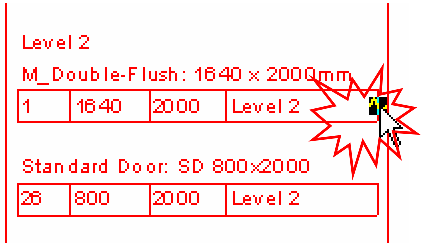
60. From the Project Browser select the Sheet **A110 – Schedules** and open it by double-clicking.

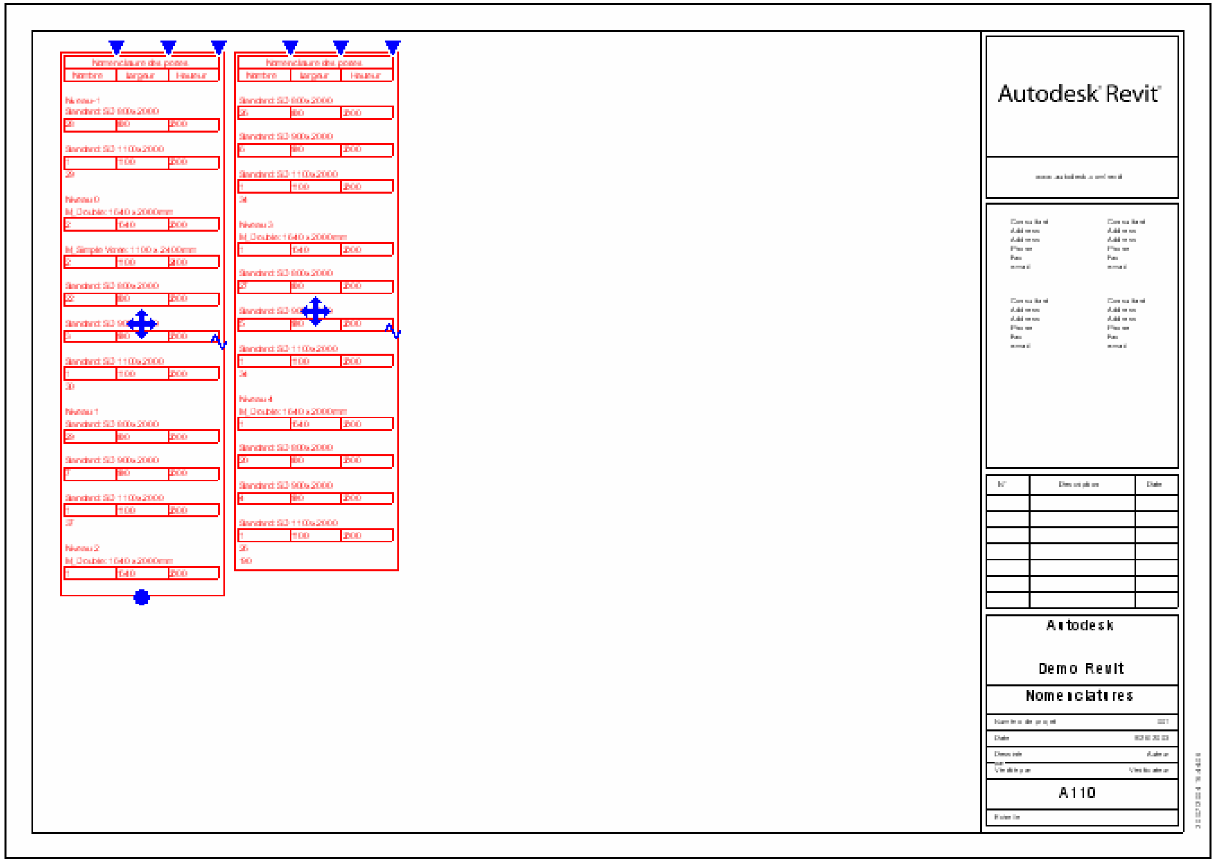
61. From the Project Browser, drag the **door schedule** table to the sheet you just created.



As you can see, the schedule table is too long for the sheet. You need to adjust it.

62. Click the schedule on the sheet, and use the small symbols to split the schedule table, as it is too long for the sheet.





You have just split the schedule table in two parts that are placed next to each other. You can still modify the width of the columns and the height of the split parts. Here are the meanings of the different symbols:

- Allows dimensioning of the column width (select, hold, move, and release at the desired position). Note that when you change the width of a column on one part of the split table, it changes in all other parts.
- Allows horizontal splitting of the table. Click the symbol and it's done. To reunite the split parts, select one part and move it over the other. Revit Building automatically reconnects the parts.
- Allows you to move the table (click, hold, move, release).
- Allows you to change the height of a split part of a table (click, hold, move, release). The allowed moves are up and down. Obviously, changing the height of one schedule part means changing the height of the other. Try it out!

63. Save and close the project.

The next exercise creates a room schedule in the same project. If you are going to work through the next exercise, you can keep this project open.

Unit 18, Exercise B: Room Schedules, Room Objects, and Room Tags

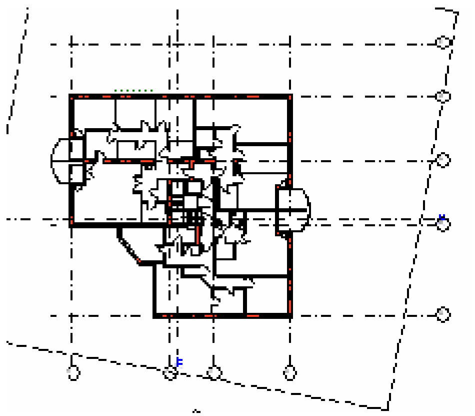
In this exercise you work with the room schedule and tags. In the last exercise, we did not address the issue of tags. To work with or create a door schedule, all you need are the doors in a project. The tags just present information already associated with the door or in the schedule. The same is true for room schedules. A room does not appear in a schedule unless you place a room object.

The exercise uses the same data set as the previous exercise, but does not build on the information created in that exercise.

Create a Duplicate View of the 2nd Floor

1. From the File menu choose **Open>Browse** to find the file **Unit 18b – Start.rvt** delivered with the workbook and open it.

2. From the Project Browser, Verify **Level 2** is current.



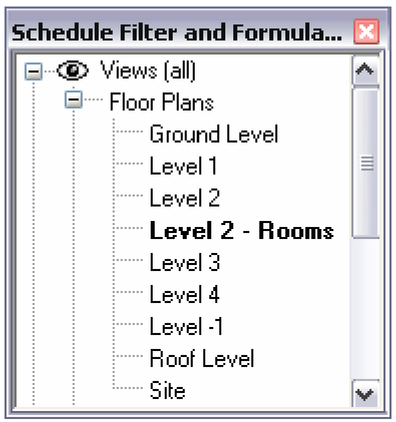
When you create a schedule view, it can be useful to duplicate the plan view in question so you have one plan view free of tags and colors.

3. Right-click the **Level 2** view and choose **Duplicate**.

4. Right-click the **copy of Level 2** view and choose **Rename**.

5. Change the **Name** to **Level 2- Rooms**.

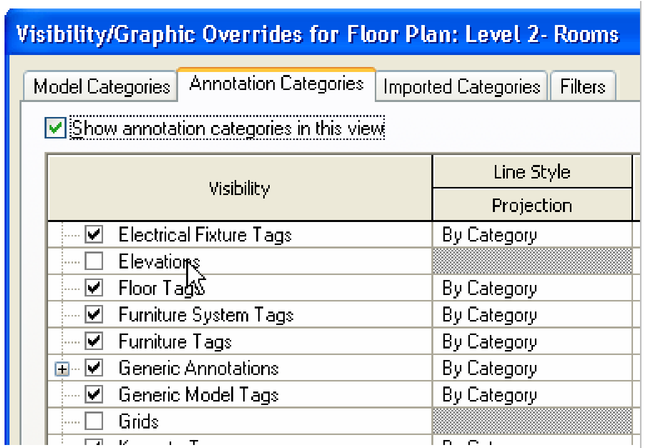
6. Click **OK**.



The duplicated view automatically becomes the active view.

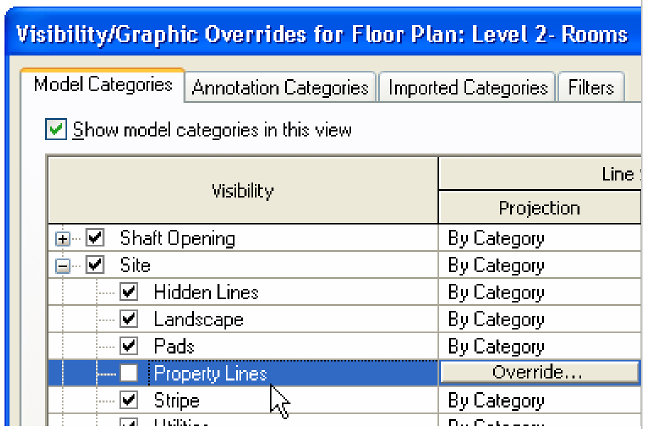
7. From the View menu, choose **Visibility/Graphics**.

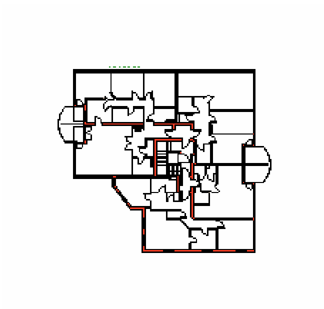
8. In the dialog box, click **Annotation Categories** and clear **Grids, Sections,** and **Elevations**.



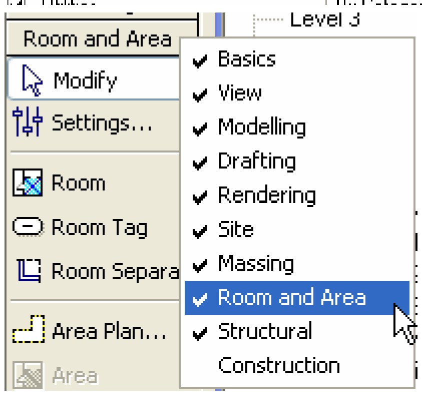
9. In the **Visibility/Graphics** dialog box, click the **Model Categories** tab and clear **Property Lines** under the **Site** category.

10. Click **OK**.



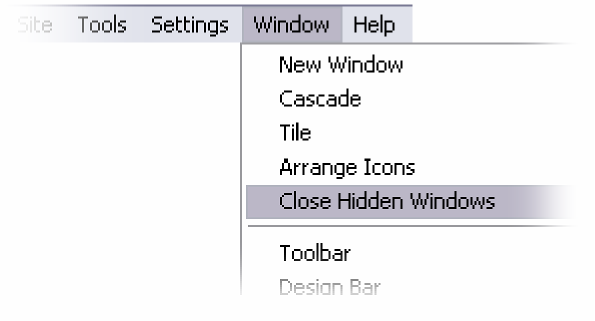


11. Right-click the Design Bar and verify that Room and Area is checked.



This step enables the Room and Area tab of tools on the Design Bar.

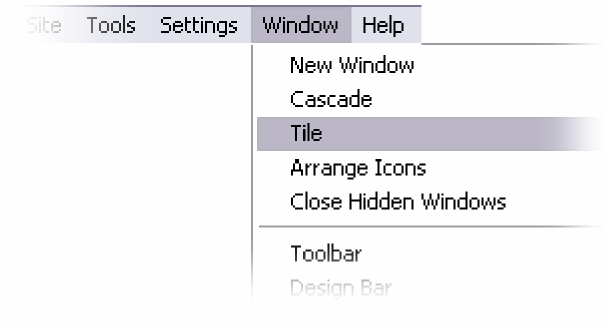
12. With the same view **Level 2 – Rooms** active, from the Window menu, choose **Close All Hidden Windows**.



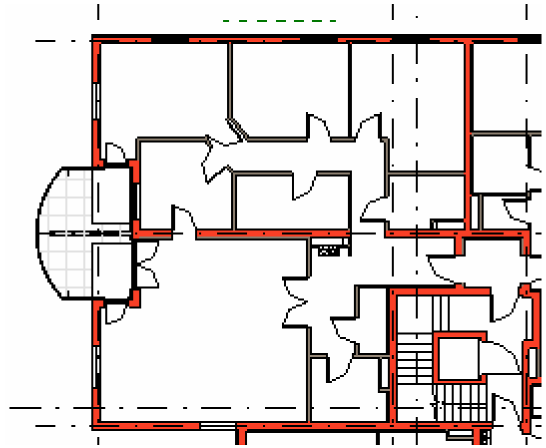
Before you start tagging your plan, split the screen so you can simultaneously view the Level 2 - Room view as well as the Door Schedule (level 2).

13. From the **Project Browser**, activate the **Door Schedule (Level 2)**.

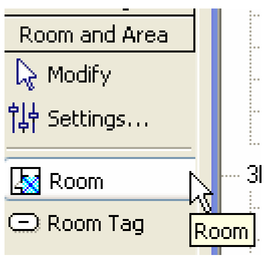
14. From the **Window** menu, choose **Tile** to see both views parallel.



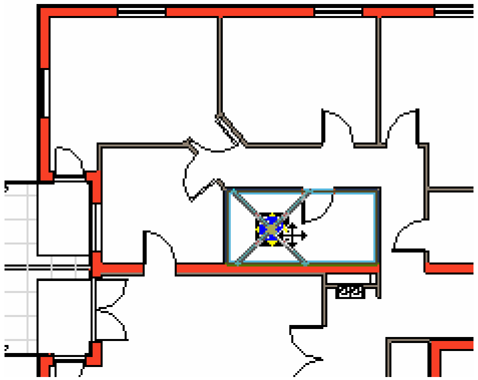
15. In the plan view, zoom into the upper-left quadrant of the plan.



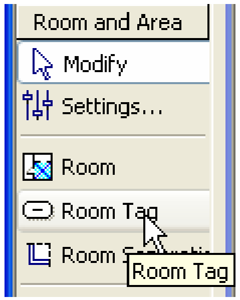
16. On the Room and Area Design Bar, click **Room** and set the Options Bar settings as shown at right.



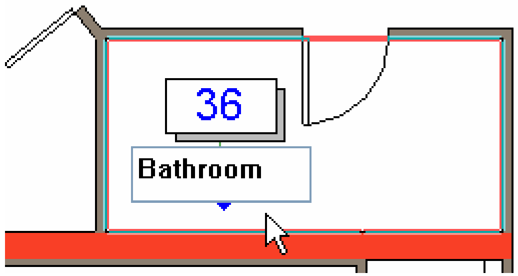
17. Click the center room shown here.

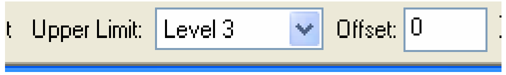


18. Click the Room Tag tool and tag (click) the room you just added.

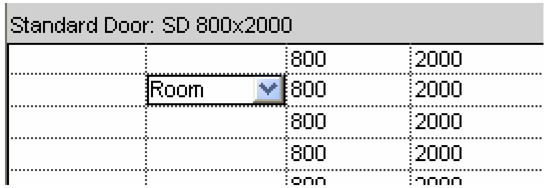


19. Click the tag and change the room name from Room to Bathroom.





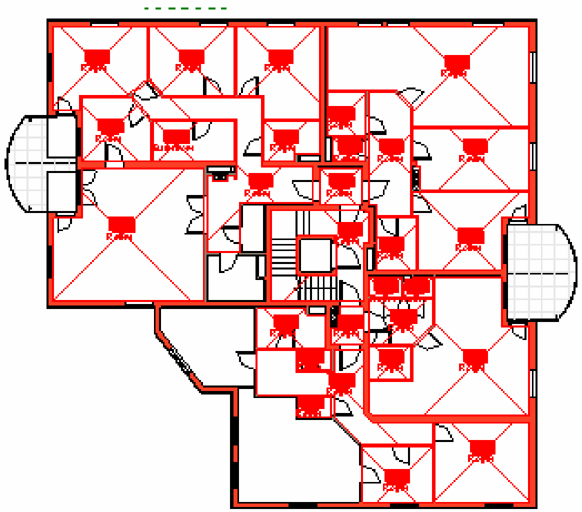
After you place the room, you should be able to hover over the room and see an "X" in the room. This is the room object. You should also now see the room in the door schedule under the To Room column.



Standard Door: SD 800x2000			
		800	2000
	Room	800	2000
		800	2000
		800	2000

20. On the Room and Area Design Bar, click the **Room** tool. Set the parameters in the Options Bar as shown.

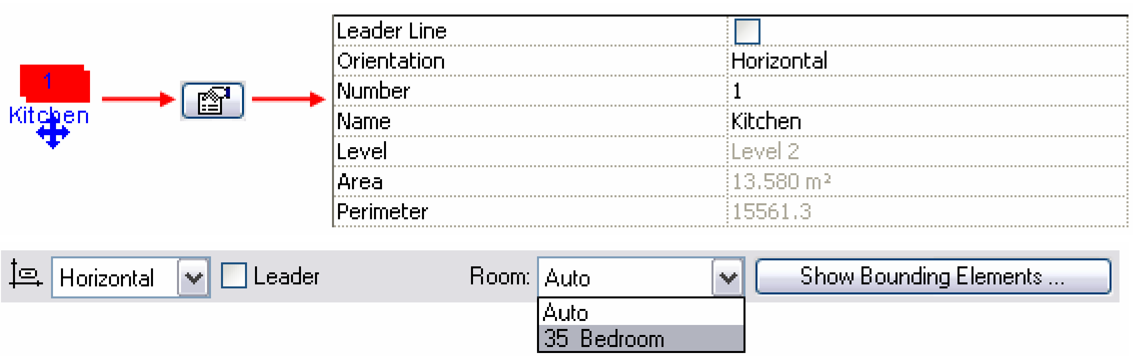
21. Click all rooms except for the two rooms on the lower left. Don't worry about the name or number of the rooms you are tagging at the moment.



Note how the door schedule updates automatically with each room tag definition. For the moment, all rooms are named "Room." That changes later as you define the exact room names elsewhere in the project. Revit Building automatically populates that change within this schedule table as well.

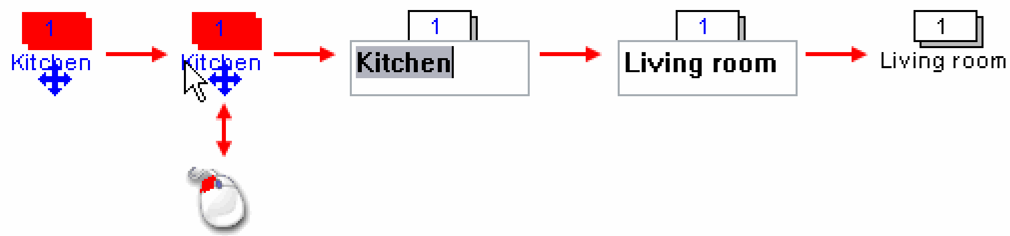
You now proceed with the correct naming of your rooms. Revit Building offers many different ways to do that.

At any time you can select a tag to modify its properties. However, this method requires a lot of manipulation and isn't very effective.



Autodesk Revit Building also allows modification of the names of the rooms from within the schedule table itself. For this, however, you need to have created the room schedule, something you have not yet done. Although the room names appear in your door schedule table, you cannot modify them from here. When the room schedule is created before the actual tagging and with the condition that the room names exist in that table, you can select that room as soon as it has been inserted using the Options Bar.

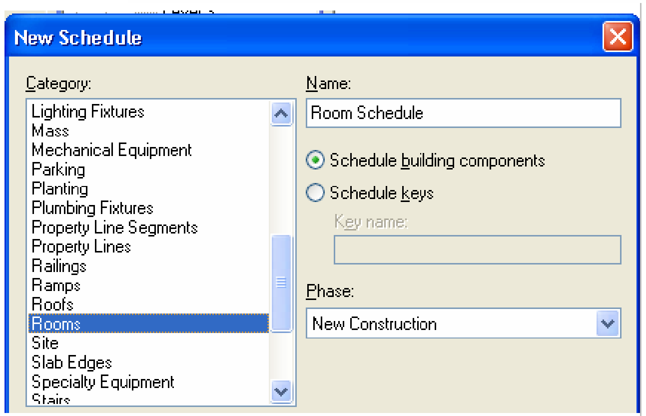
22. Using that principle, you are now going to change the name of each room. You may sometimes use the same names (Living Room, Bathroom). Try to name four apartments on this level.



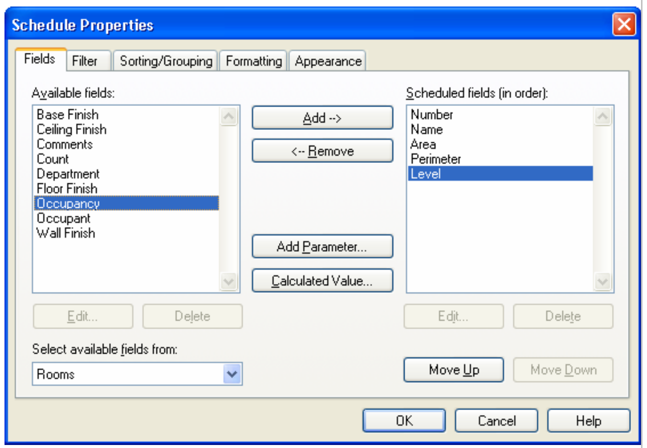
You now create a room schedule table listing those values.

23. On the **View tab** of the Design Bar, select **Schedule\Quantities**.

24. Select **Rooms** as a category, and click **OK**.

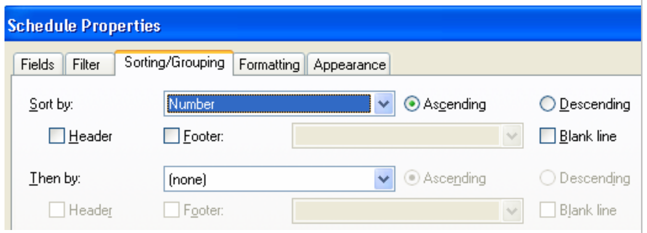


25. In the **Schedule Properties** dialog box, add the fields **Number, Name, Area, Perimeter,** and **Level**.



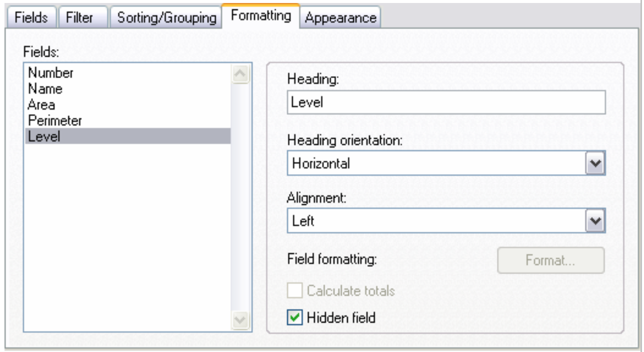
26. Click the **Sorting/Grouping** tab.

27. Under **Sort By**, select **Number**.



28. Click the **Formatting** tab.

29. Select **Level** and select the **Hidden Field** check box.

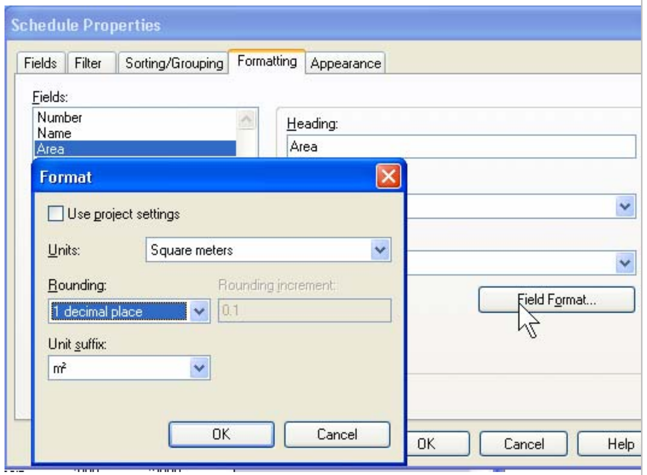


30. Select **Area** and click **Field Format**.

31. Clear the **Use Project Settings** check box, and then set Square Meters as Units, **1 Decimal Place** as rounding**,** and **m2** as Unit Suffix.

32. Repeat for the Perimeter field (set units as square meters, rounding one decimal place).

33. Click **OK** to return to the schedule window.



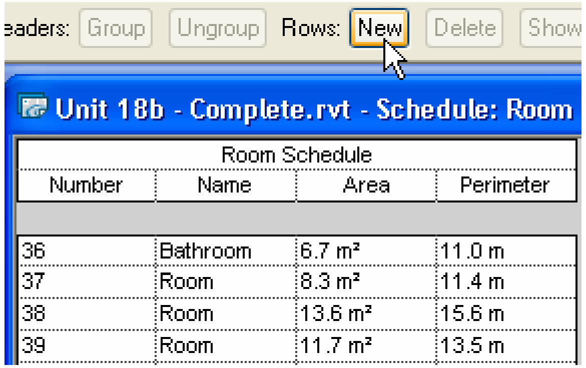
Room Schedule

Number	Name	Area	Perimeter
36	Living Roo	37.7 m²	25530
37	Dining roo	8.3 m²	11317
38	Living Roo	13.6 m²	15561
39	Bedroom	11.7 m²	13490
40	Bathroom	6.7 m²	11005
41	Bedroom	14.2 m²	15800
42	Corridor	19.0 m²	43689
43	Laundry	4.1 m²	8600
44	Bathroom	3.4 m²	7370
45	Living Roo	35.2 m²	26826
46	WC	1.7 m²	5200
47	Corridor	10.1 m²	14453
48	Room	14.1 m²	15783
49	Bedroom	14.8 m²	17497
50	Room	4.1 m²	8207
51	Corridor	3.0 m²	6910
52	Living Roo	30.5 m²	26338

Adding Rooms via the Room Schedule

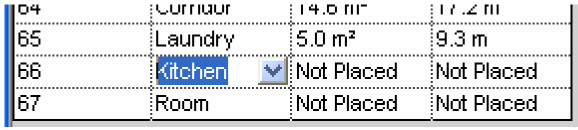
You can use the Add Rows button on the schedule to create rooms that are unassigned. Once you are adding rooms these rooms are available from the Options Bar pull-down menu.

34. Set the room schedule view current, and click the New row button two times.

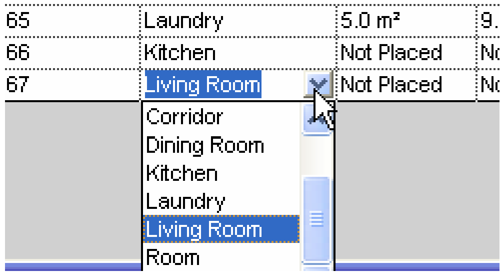


If you have not used the room name Kitchen you can just type the entry in the cell in the schedule.

35. Type Kitchen for the name for the first row that appears at the bottom of the schedule.

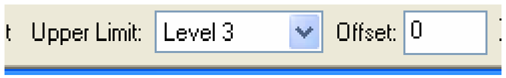


36. Click in the room name cell for the second row you added. Select Living Room from the list.



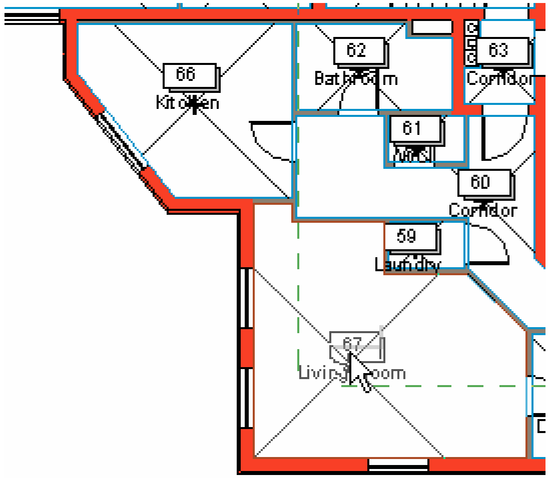
If you have entered a value, you can pick it using the drop-down list in the schedule cell.

37. On the Room and Area Design Bar, click **Room** and set the Options Bar settings as shown at right.



Any unassigned room is available from the room pull-down on the Options Bar.

38. Add the kitchen and living room as shown at right.



In this same manner you can use the Options Bar to delete any room in the schedule.

If the room has not been placed in the project yet, it is simply deleted from the schedule.

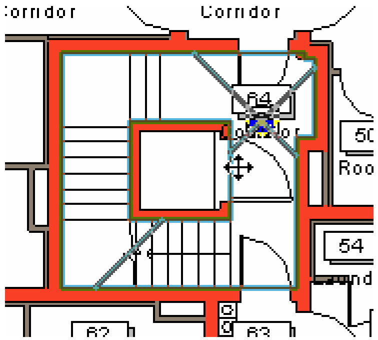
If the room exists as an object in the project you receive a warning that you are deleting the room and the tag associated with it.

Separate Rooms

In this section you add room separation lines to separate out the stair from the corridor area.

39. Find the corridor in the center of the building.

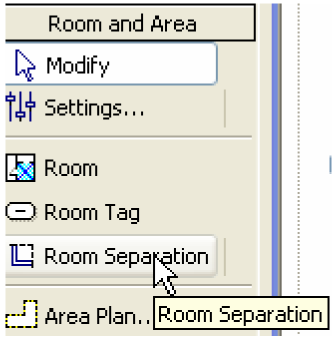
40. Click that room number in the schedule, and then on the Options Bar, click Show.



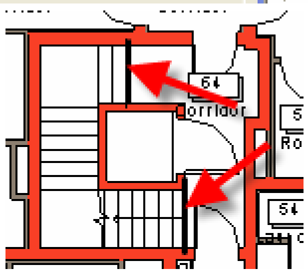
The plan zooms to this room, the same as the Show button on the door schedule functions.

Note the stair and corridor are the same space.

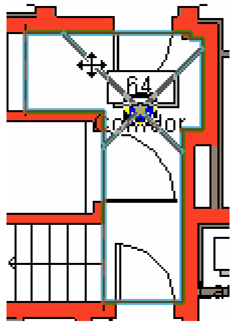
41. On the Design Bar, click the **Room Separation** tool.



42. Draw lines from wall to wall at the treads.



43. Click the room object to verify that it extends only to the risers at these locations.

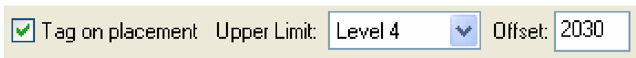


Add a Multifloor Spanning Room

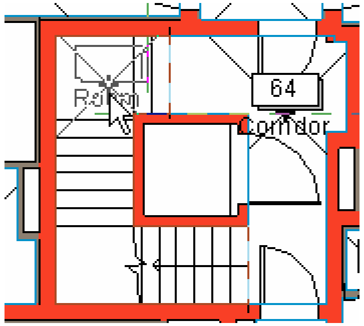
Stairs and how their areas are calculated vary from region to region. Often, stairs, atriums, or other spaces that span multiple floors are calculated only once. To do this, the room must have parameters that tell it to extend the full height of the buildilng.

In this case, the stair extends from level 1 up to level 4 with an offset above level 4 of 2030 (the height at which is hits the roof object.

44. Click the Room tool, and set the parameters in the Options Bar as shown.

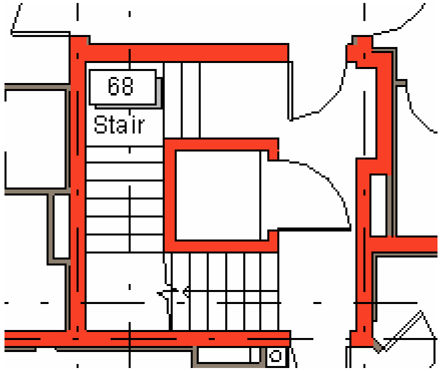


45. Click the area of the stair to place this room.



46. Click the tag, and change the name from Room to Stair.

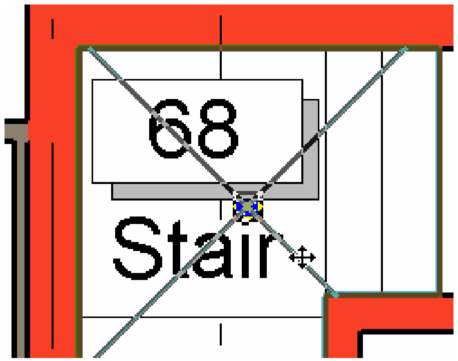
47. Open Level 3 plan view.
48. Click the Room Tag tool.
49. Click the same area to tag the stair room in this view.



The room object extends up through this floor level and so is found by the tag.

None of the other spaces on this floor have a room object and thus cannot be tagged by the tool.

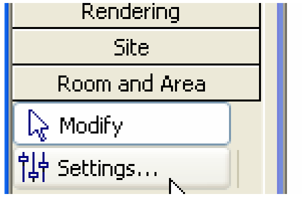
50. Click the stair's room object.
51. On the Options Bar, click **Properties**.



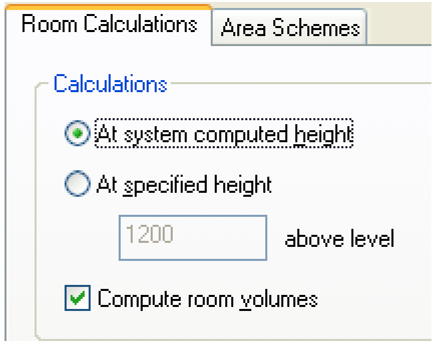
Add a Volume Column to the Room Schedule

If you turn on volume in the room and area settings, you can then add the volume column to the room schedule.

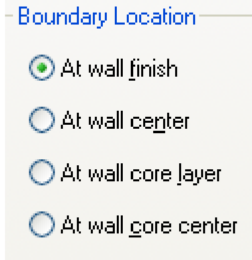
52. On the Design Bar, click **Room and Area>Settings tool**.



53. Click Compute Room Volumes.

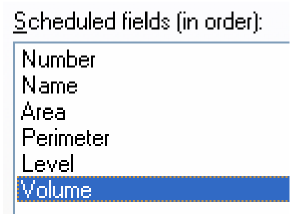


This dialog box also gives you control over how the room areas are calculated.



54. Set the Room schedule current and open its view properties.

55. Edit the fields to add Volume to the schedule.



56. Click OK to return to the schedule

Room Schedule				
Number	Name	Area	Perimeter	Volume
36	Bathroom	6.7 m²	11.0 m	17.53 m³
37	Dining Room	8.3 m²	11.4 m	21.94 m³
38	Living Room	13.6 m²	15.6 m	35.71 m³
39	Bed Room	11.7 m²	13.5 m	30.72 m³
40	Living Room	37.7 m²	25.6 m	99.08 m³
41	Bed Room	14.2 m²	15.8 m	37.40 m³
42	Corridor	18.5 m²	34.2 m	48.75 m³
43	Laundry	4.1 m²	8.6 m	10.82 m³

The Schedule now reports volume for each of the rooms in the project.

Unit 18, Exercise C: Calculated Values for Rooms

Using a room schedule table, you can easily create another in which you directly read the total of each room (kitchen, living room, room) as well as the percentage of that room type according to the total area of the building.

1. From the File menu, choose **Open>Browse** to find the file **Unit 18c – Start.rvt** delivered with the workbook and open it.

   In the Project Browser, duplicate the room schedule and name it **Room Schedule (Level 2 – Surfaces)**.

2. Right-click the new schedule, and choose **Properties.**

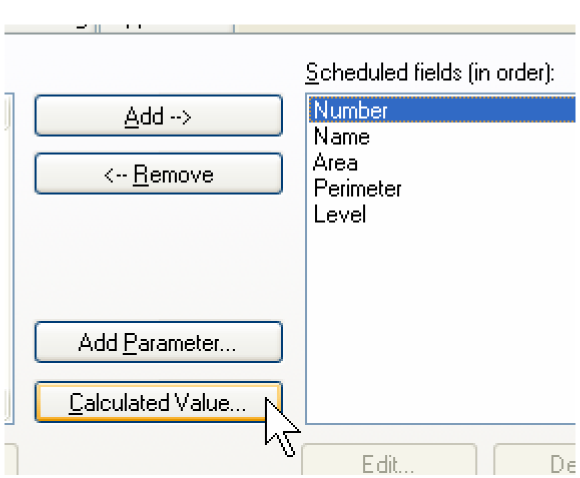
3. Click the **Edit** button next to **Fields**.

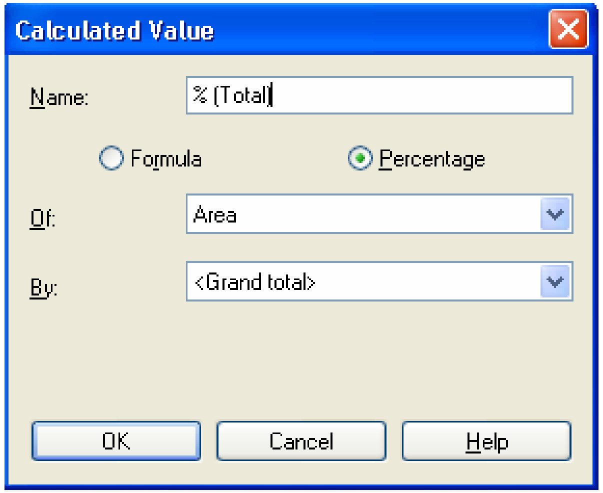
4. On the **Fields** tab, click the **Calculated Value** button.

5. In this dialog box set the following:

6. Next to **Name**, enter a name for the new field **(% (Total),** for example).

7. Select the **Percentage** radio button.
8. Next to **Of** select **Area**.
9. Next to **By** select **Grand Total**.





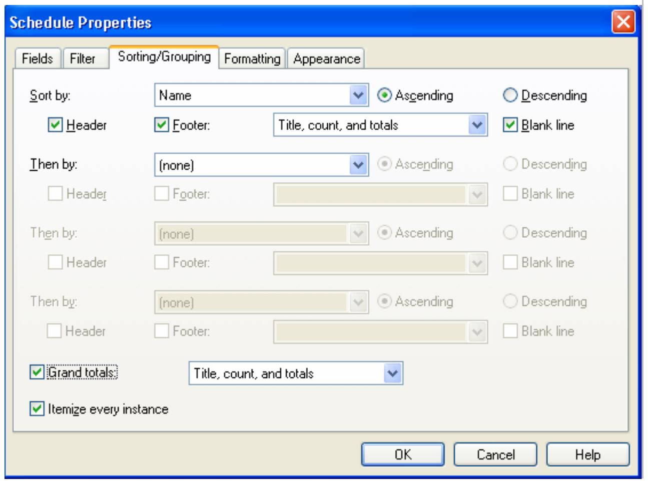
10. Click the **Sorting/Grouping** tab.

11. Change the sorting condition to **Name**.

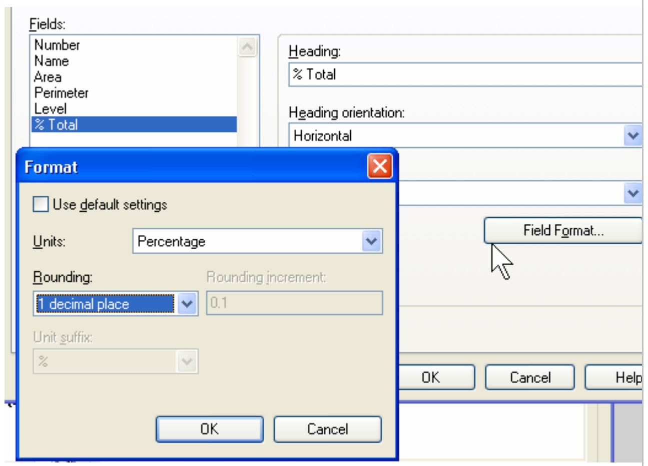
12. Select **Header** and **Footer** (keep **Title, Count,** and **Totals**).

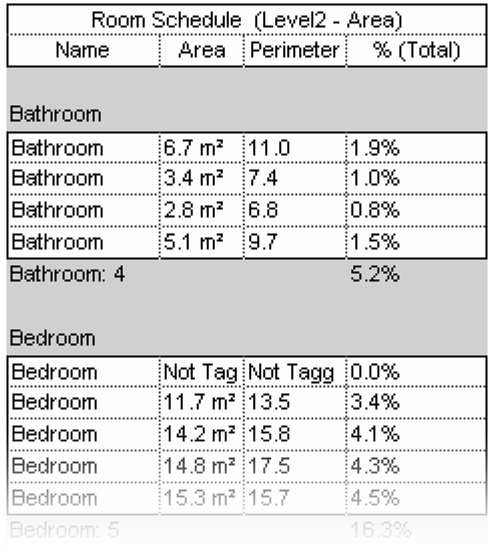
13. Select **Blank Line**.

14. Select **Grand Total** (keep the **Title, Count,** and **Totals**).



15. Click the **Formatting** tab.
16. Select the calculated field that you created previously (%Total).
17. Select **Calculate Totals**.
18. Click **Field Format**.
19. Next to **Units,** select **Percentage, Rounding 1 Decimal Place**.
20. Click **OK** to return to the schedule.





Room Schedule (Level2 - Area)			
Name	Area	Perimeter	% (Total)
Bathroom			
Bathroom	6.7 m²	11.0	1.9%
Bathroom	3.4 m²	7.4	1.0%
Bathroom	2.8 m²	6.8	0.8%
Bathroom	5.1 m²	9.7	1.5%
Bathroom: 4			5.2%
Bedroom			
Bedroom	Not Tag	Not Tagg	0.0%
Bedroom	11.7 m²	13.5	3.4%
Bedroom	14.2 m²	15.8	4.1%
Bedroom	14.8 m²	17.5	4.3%
Bedroom	15.3 m²	15.7	4.5%
Bedroom: 5			16.3%

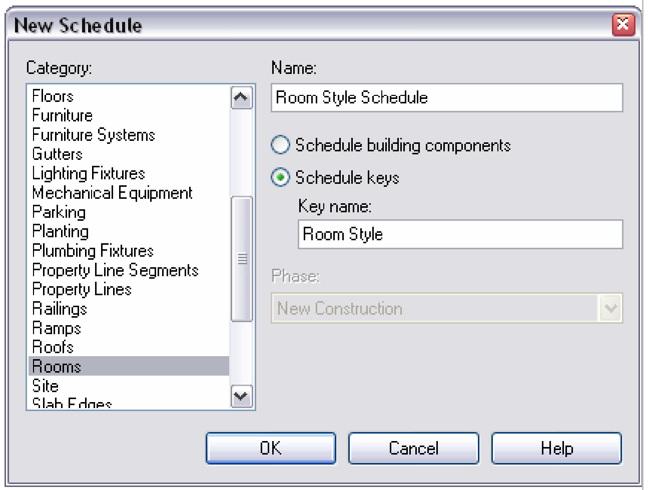
Unit 18, Exercise D: Room Schedule Keys

In this exercise you add room finish keys to the schedule.

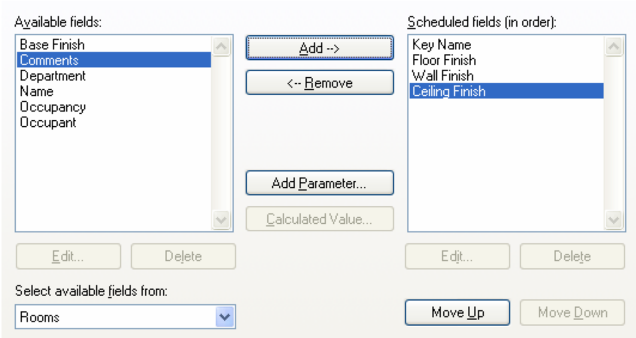
To finish your schedule table, you are going to create a schedule key. The idea is to be able to associate to each room a finish for the walls, floor, and ceiling. Instead of tediously copying and pasting these values to each room, you prepare a new schedule in which all those finishes are listed and then link it to your room schedule.

1. From the File menu, choose **Open>Browse** to find the file **Unit 18d – Start.rvt** delivered with the workbook and open it.
2. On the Views Design Bar, click **Schedule/Quantities.**
3. From the **Category** list select **Rooms**.
4. Select **Schedule Keys**.
5. You can change the name of the schedule if you want to.

6. Click **OK**.



7. Under Available Fields, select **Floor Finish, Wall Finish,** and **Ceiling Finish**.

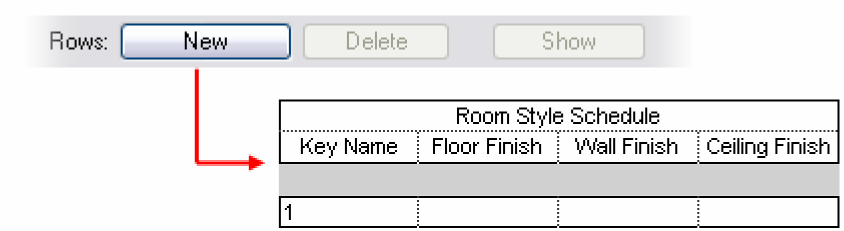


The Key Name field is automatically generated. It is this field that creates the link between the two schedules. So, do *not* delete it!

8. Click **OK**.

The schedule key tables are usually empty when created. Your next task is to fill it with all the necessary information.

9. On the **Options Bar**, click **New**.



In principle you should now fill out all the information you have about all possible finishes. The first column is automatically generated as a numeric column in which the number increments with every added line. You can change the numbers but you *cannot* duplicate numbers.

Next, you link this schedule to the room schedule so that you can use these values within it.

New

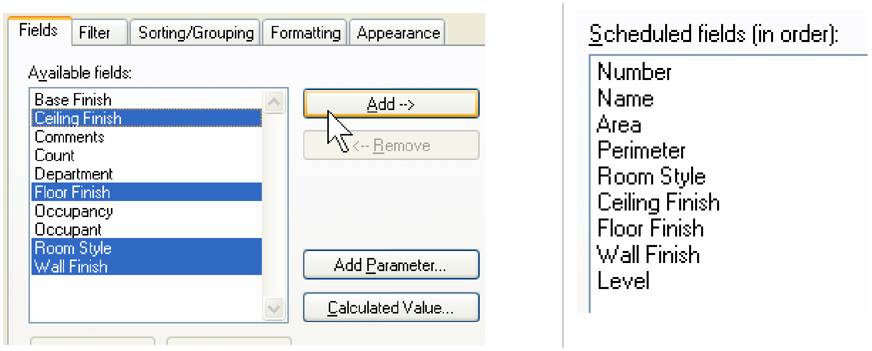
Room Style Schedule			
Key Name	Floor Finish	Wall Finish	Ceiling Finish
1	vinyl	wallpaper	white paint
2	vinyl	beige paint	white paint
3	carpet	wallpaper	white paint
4	tiles	wallpaper	white paint
5	wood	wallpaper	white paint

10. From the **Project Browser** right-click the **room schedule** and choose **Properties**.

11. Click the **Edit** button next to **Fields**.

12. Under **Available Fields**, you can now add the following fields: **Room Style, Floor Finish, Wall Finish,** and **Ceiling Finish**.

13. Click **OK** to return to the room schedule.



The principle is simple: you click the **Room Style** fields and select the key corresponding to the finishes in that room. The Floor, Wall, and Ceiling Finish columns are automatically filled.

Room Schedule							
Number	Name	Area	Perimeter	Room Style	Floor Finish	Wall Finish	Ceiling Finish
1	Living room	13.6 m^2	15.6	5	wood	wallpaper	white paint
2	Bedroom	11.7 m^2	13.5	3	carpet	wallpaper	white paint
3	Bedroom	14.2 m^2	15.8	3	carpet	wallpaper	white paint
4	Dining room	8.3 m^2	11.3	5	wood	wallpaper	white paint
5	Bathroom	6.7 m^2	11.0	4	tiles	wallpaper	white paint
6	Corridor	18.0 m^2	43.7	(none)			
7	Laundry	4.1 m^2	8.6	1			
8	Living room	37.7 m^2	25.5	2			
9	Laundry	5.0 m^2	9.3	3			
10	WC	2.0 m^2	6.2	4			
11	Corridor	3.0 m^2	6.9	5			
12	Living room	35.2 m^2	26.8	(none)			

Unit 18, Exercise E: Color Fills

In this exercise you create a color fill legend to give a visual indicator to the information held in the room objects.

1. From the File menu, choose **Open>Browse** to find the file **Unit 18e – Start.rvt** delivered with the workbook and open it.

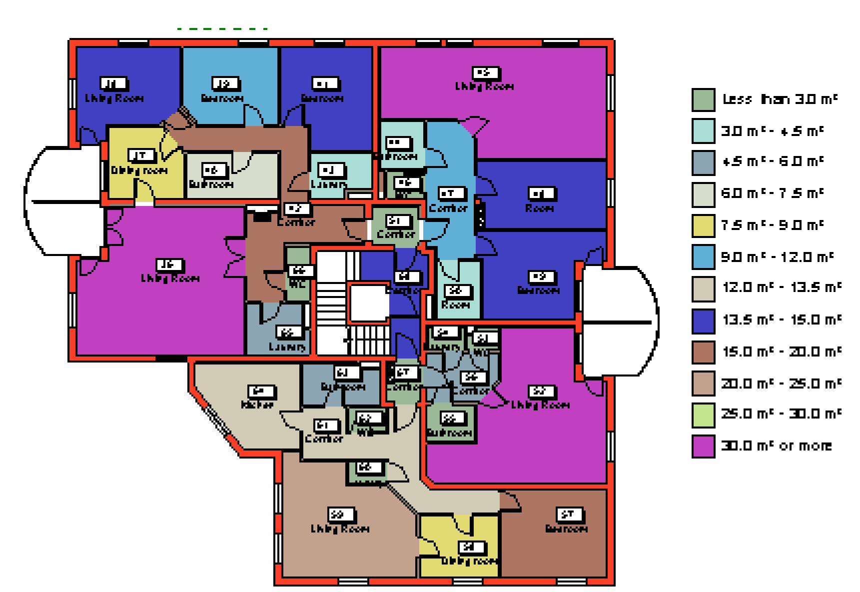
Add a Color Fill

To finalize your plan, you add a color fill of the areas.

2. From the **Project Browser**, activate **Level 2 - Room Areas.**

3. From the **Drafting** menu, choose **Color Fill** and place the legend next to the floor plan.

4. Click OK in the information dialog box telling you it will disable visibility.



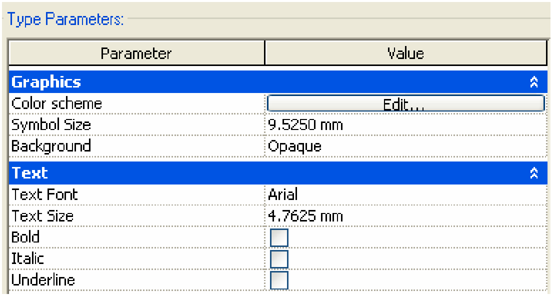
Autodesk Revit Building automatically fills each tagged room with the corresponding color. All rooms with the same area are given the same color defined in the legend. These colors can be modified at any point and that change is populated on the legend, as well as in the entire drawing.

5. Select the legend.

▼ Allows redimensioning of the width of the legend. If the legend has more than one column, you can change their widths independently.

⬤ Allows you to redimension the height of the legend. Should the height you are setting not be sufficient for the entire legend, Revit Building automatically splits the legend into various columns.

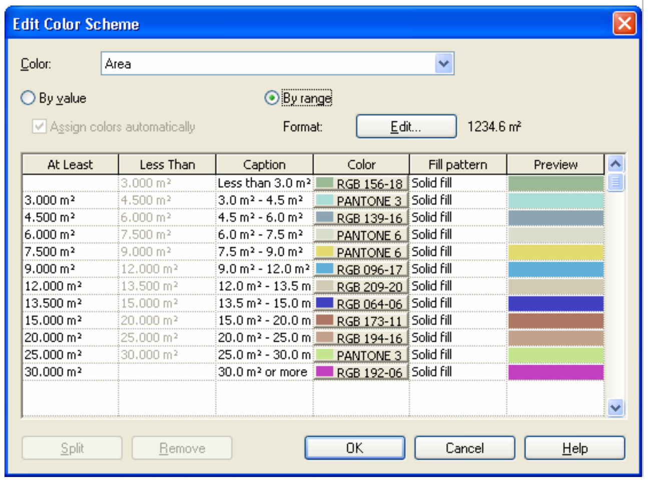
6. Click **Properties** (the legend should still be selected). Click **Edit/New** and under **Color Scheme**, click the **Edit** button.



You can also change the size of the color box in the legend (symbol size) as well as all text attributes (font, size, bold, italic, underline).

The Edit button is also represented directly on the Options Bar. Its use is explained in the coming steps.

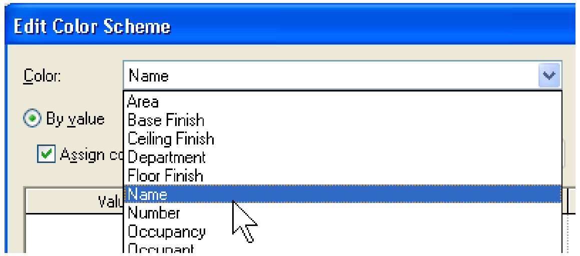
7. Click **Cancel** to close all dialog boxes.
8. Select the color fill legend again, and on the Options Bar, click **Edit Color Scheme**.

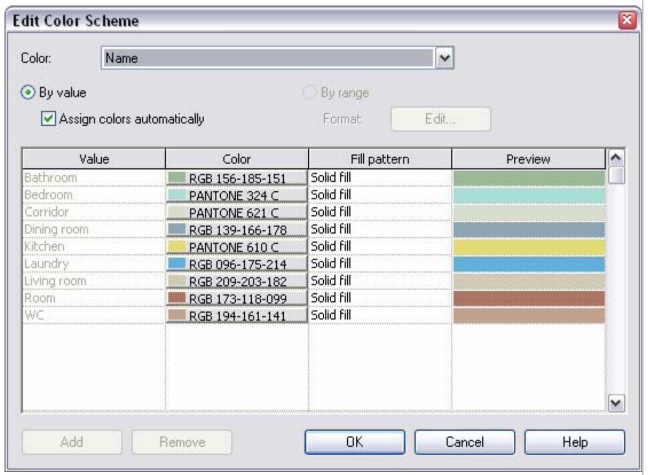


The default color scheme for this project is set to color the rooms by area range.

In principle, By Range works the same way as By Value. To modify the conditions of the color fill, fix a minimum value (default: 20m²) and click the Split button. The first condition you get is a double of the start condition. If you continue to split, the result depends on which cell was active when you clicked the Split tool. In any case, you can set any number as a value in the cells.

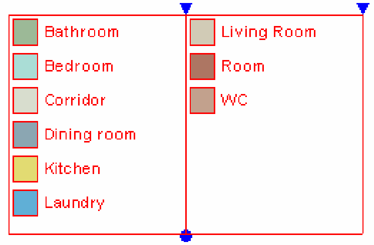
9. Change the color value to Room Name.





Many options are available for the color theme. Explore the different types of color schemes. Using the Properties page you can duplicate color themes and store them in the project as types. Once defined, you can change them directly from the Options Bar Type drop-down.

If the color scheme does not automatically fill in all the values, click OK and then Edit Color Scheme again.



You can do the following:

- Change the colors associated to certain criteria. Click the Color button and select new color.
- Change the fill pattern used for the color fill. Click Fill Pattern and select a new one.
- In the pull-down Color list, you can set the criteria according to which of the colors is applied. By default it is the name of a room, but you can change it to Floor Finish if you want. You find all possible criteria for room coloring in that list.

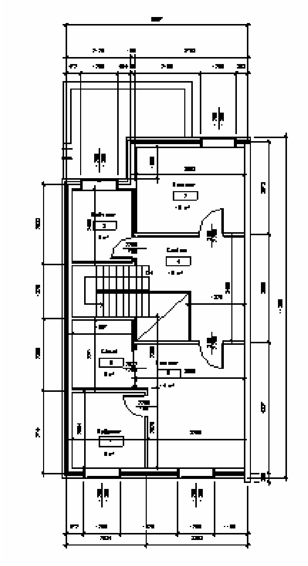
Finally, depending on the field you have chosen under Color, the option By Range may be displayed. If the chosen value is numeric (surface, length), By Range is displayed.

Unit 18, Exercise F: Legends

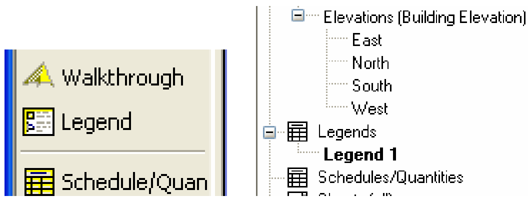
In this exercise you create a window legend. A legend is a chart of symbols in the project. You can create legends for any Autodesk Revit Building object, including walls, windows, and furniture.

Create a Legend

1. From the **File** menu, choose **Open**. Browse to the file **Unit 18f – Start** delivered with the workbook. Open it.



2. On the Design Bar, click **Views**, and then click the **Legend** tool.



This creates and opens a new view. The new view is created in its own category in the Project Browser.

3. Rename the legend **Window Legend**.

The legend view appears blank with no views of the building model. Think of a legend as a piece of paper on which you place symbols that represent the objects in the building model.

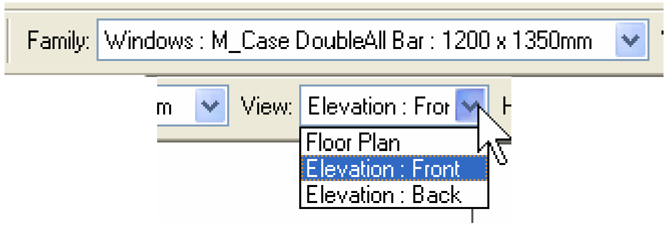
4. Click the Design Bar **Modeling tab**.

Notice that all the tools are unavailable. There is a special tool you use to add the objects in symbol mode to the legend.

5. Click the Design Bar **Drafting tab**.

6. Click the **Legend Component** tool.

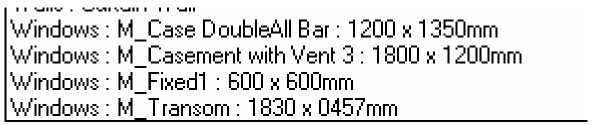
7. Use the Options Bar drop-down to select
   - Family = M_Case Double All Bar:1200x1350mm
   - View = Elevation Front

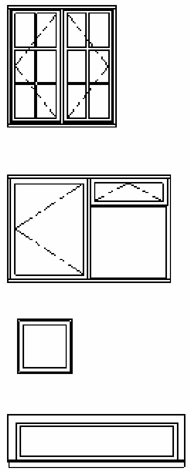


The window symbol is shown in the legend.

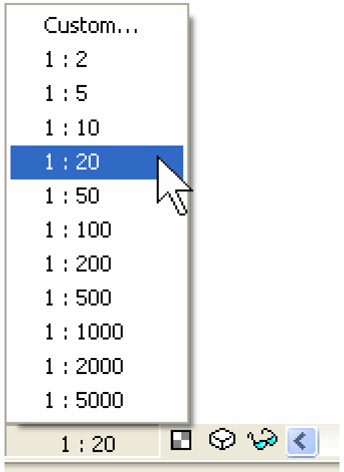
8. Click in the legend to place the window.

9. Repeat, adding the window types shown here.

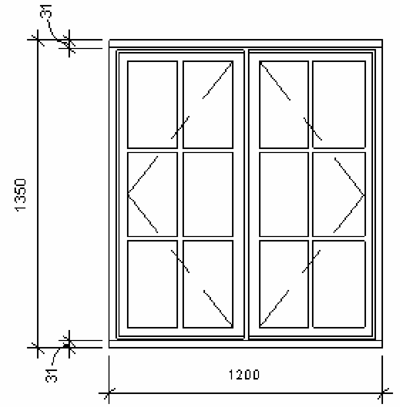




10. Change the scale of the legend to 1:20.

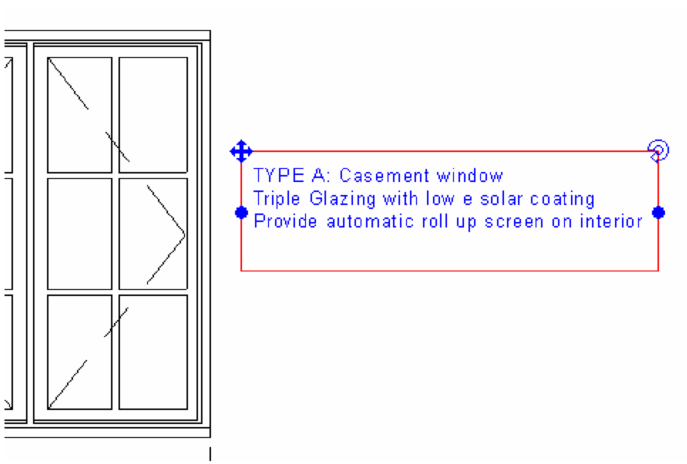


11. On the Design Bar Basic tab, use the Dimension tool to dimension the windows.



Because this is a window type, the window legend is a convenient location to place common information about this window that occurs in multiple locations in the project.

12. On the Design Bar Basic tab, use the Text tool to add notes to the legend.



13. You can place a legend on any sheet by dragging from the Project Browser.

Unit 18, Exercise G: Material Takeoffs

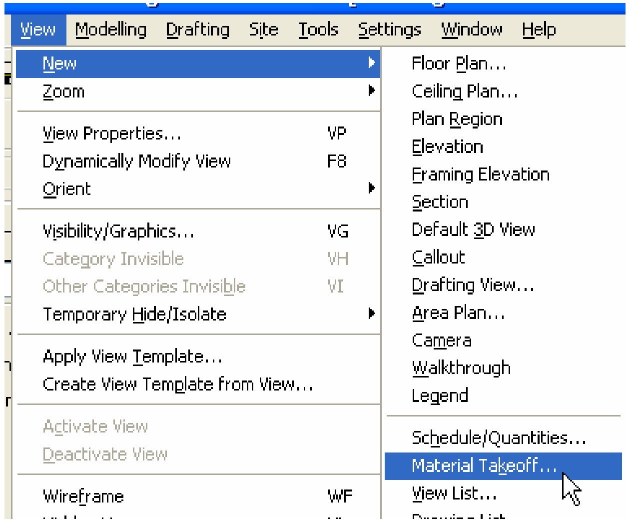
A material takeoff is just a specialized form of a schedule. This exercise leads you through creating a material takeoff view for the walls.

The exercise uses the same data set as the previous exercise but does not build on the information created in that exercise.

Create a Material Takeoff List

1. From the File menu, choose **Open>Browse** to find the file **Unit 18g – start** delivered with the workbook.

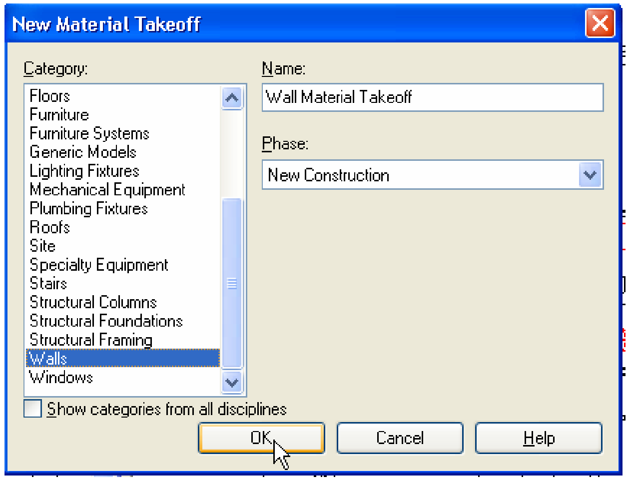
2. From the View menu, choose **New>Material Takeoff**.



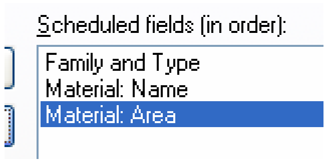
3. In the New Material Takeoff dialog box:

   a. Click Category: **Walls**.

   b. Click **OK**.

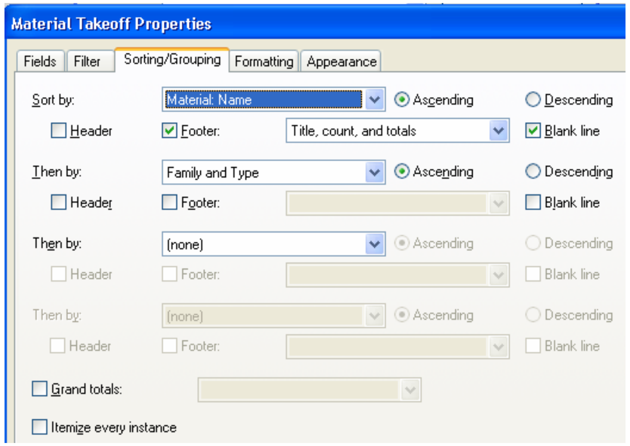


4. On the Field tab add the fields shown in the illustration at right.

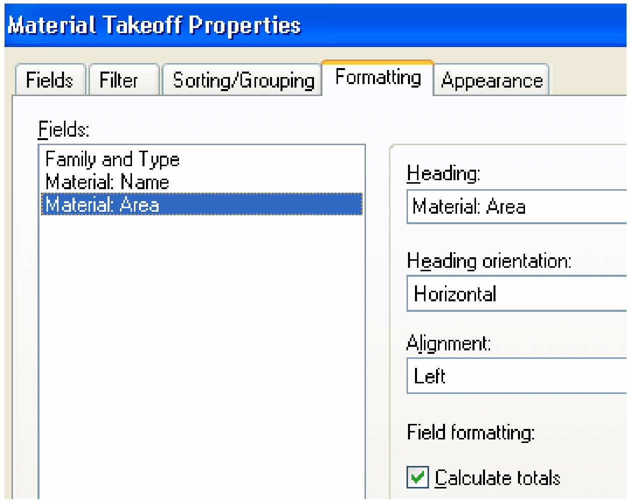


5. Leave the Filter set to None.

6. On the Sorting/Grouping tab:
   a. Set Sort By to Material Name.
   b. Select Footer, and set to Title Count and totals.
   c. Check Blank Line for this sort criterion.
   d. Clear Itemize Every Instance.



7. On the Formatting tab:
   a. Click **Material: Area**.
   b. Select **Calculate Totals**.



8. Click **OK**.

Wall Material Takeoff		
Family and Type	Material: Name	Material: Area
Basic Wall: Exterior - Brick on Mtl. Stud	Air Barrier - Air Infiltration Barrier	181 m²
Air Barrier - Air Infiltration Barrier: 7		181 m²
	Default Wall	157 m²
Default Wall: 11		157 m²
	Finishes - Interior - Plasterboard	376 m²
Finishes - Interior - Plasterboard: 23		376 m²
	Masonry - Brick	185 m²
Masonry - Brick: 9		185 m²
	Masonry - Stone	30 m²
Masonry - Stone: 5		30 m²
	Metal - Stud Layer	278 m²
Metal - Stud Layer: 23		278 m²
Basic Wall: Exterior - Brick on Mtl. Stud	Misc. Air Layers - Air Space	179 m²
Misc. Air Layers - Air Space: 7		179 m²
Basic Wall: Exterior - Brick on Mtl. Stud	Vapour / Moisture Barriers - Vapour Reta	181 m²
Vapour / Moisture Barriers - Vapour Retarder: 7		181 m²
Basic Wall: Exterior - Brick on Mtl. Stud	Wood - Sheathing - plywood	178 m²
Wood - Sheathing - plywood: 7		178 m²

The schedule of materials is now part of the project. On your own add the cost field and add a calculated parameter than multiplies the area field time the cost field.

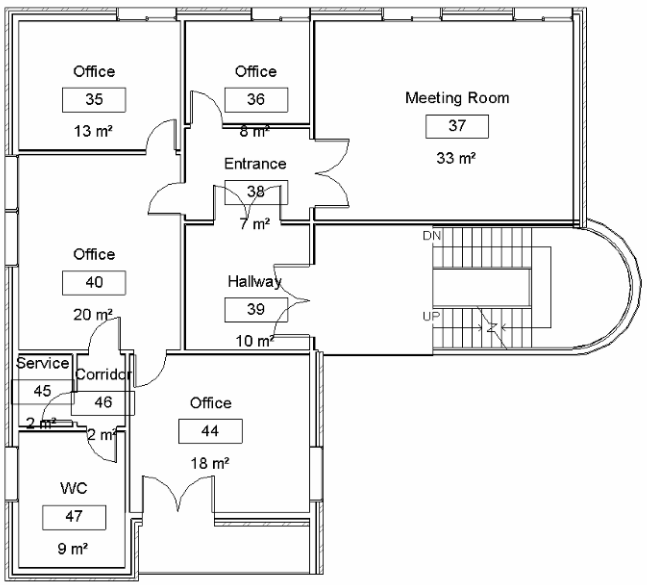
Unit 19

Theory: Time

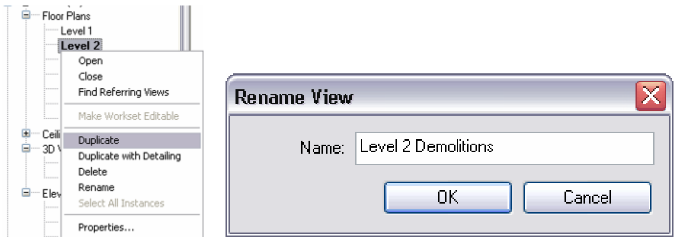
Autodesk Revit Building: Walkthrough and Phasing

This unit explains how the time parameter is managed in Autodesk Revit Building.

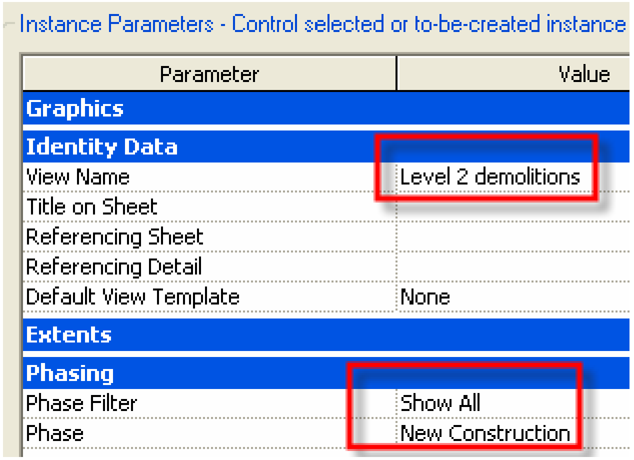
1. Open **File Unit 19 – Start**.



2. In the Project Browser, right-click **Floor Plan Level 2** and **Duplicate** the view. Rename the new view **Level 2 Demolitions**.

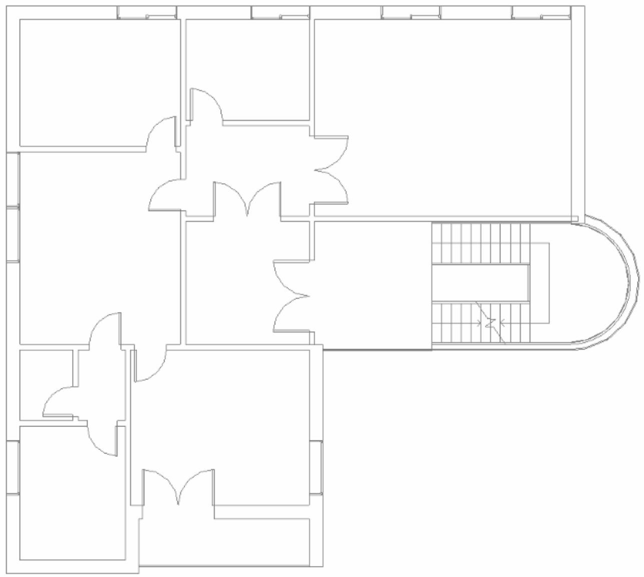


3. Open the **View Properties** for Level 2 Demolitions and change the **Phase Filter** to **Show All** and **Phase** to **New Construction**.



To open View Properties you can right-click the view in the Project Browser and choose Properties, or right-click anywhere in the view and choose View Properties from the context-sensitive menu.

4. Click **OK** to close the dialog box.



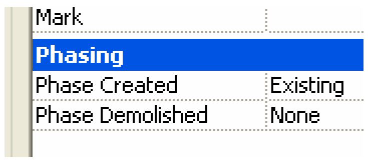
Note how the appearance of the existing components changes when the phase of the view is changed.

The first thing you should notice is that views have a parameter called phase.

Depending on the value of this parameter, all components created (or demolished) in this view have their created phase set as the one the view belongs to. In this case, the walls and doors you demolish were created in the existing phase and are demolished in the new construction phase.

5. Click one of the walls in the plan. Open its properties.

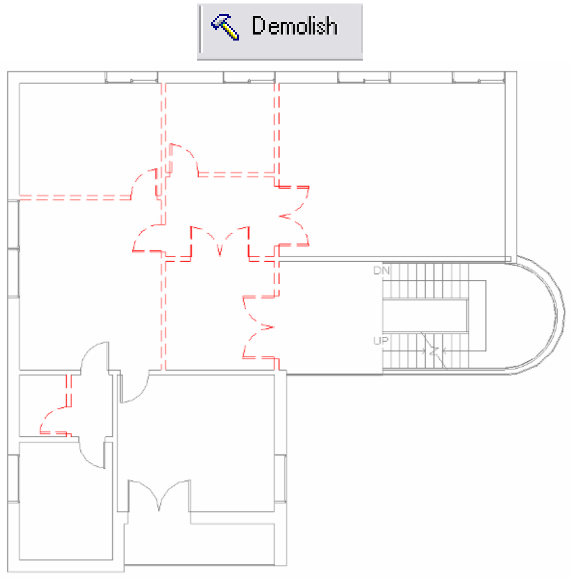
6. Verify the wall's **Phase Created** is set to **Existing** and **Phase Demolished** is set to **None**.



For every object in the building model there is also a phasing property. For each object Autodesk Revit Building tracks the phase created and the phase demolished. As noted earlier, the phase created is read from the phase property of the view in which it is created.

Demolish Walls and Doors

7. Click the **Demolish** icon on the toolbar, and then click the walls in the middle of the building (see image).



When you demolish a component, its display changes according to the phase filter assigned to the view.

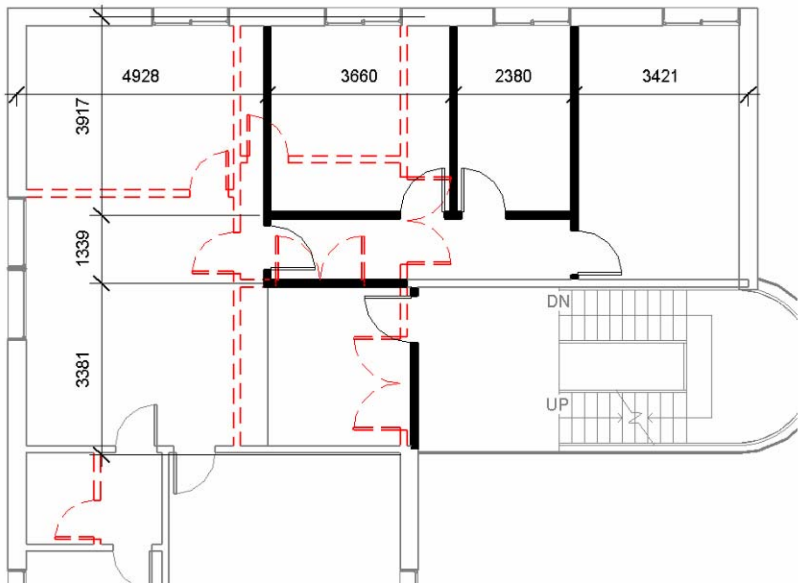
Phase filters are found in the view properties.

The override for the display of the components is defined in the phase settings: from the Settings menu, choose Phases>Graphic Overrides tab.

8. Click the wall dividing the bathroom area on the bottom left (see image).

9. Add new walls and doors as shown in image. You don't need to be exact about positioning the components, but you should design a plan that makes sense.

As you add the walls, verify that the height is set to Level 3.



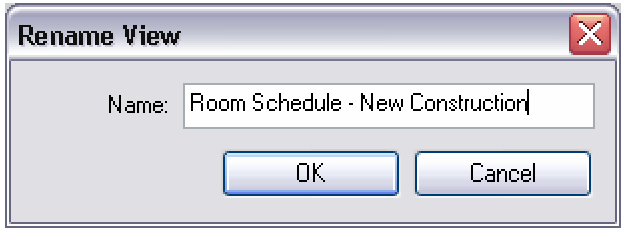
10. **Duplicate** the **Level 2 Demolitions** plan view and rename it to **Level 2 – Complete**.

11. Open the **View Properties** and change the **Phase Filter** parameter to **Show Complete**.

12. Click **OK** to exit the dialog box.

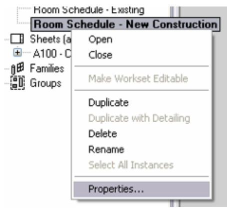
13. On the Room and Area Design Bar, click **Room** and create (and rename) the rooms as shown in the image.

14. In the Project Browser>Schedules/ Quantities, right-click the Schedule table: **Room Schedule – Existing** and **duplicate** it.



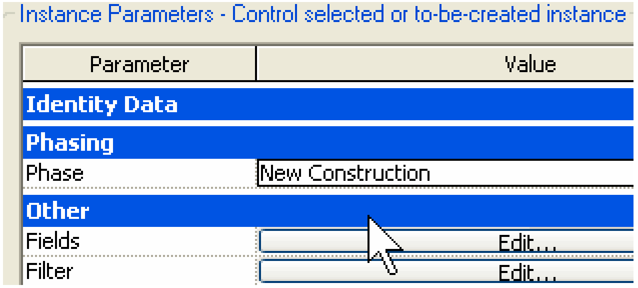
15. Rename it to **Room Schedule – New Construction**.

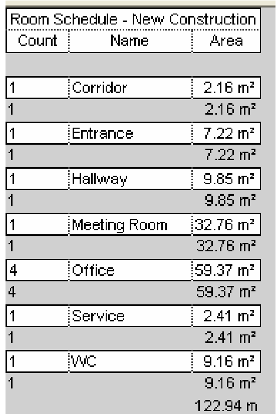
16. In the Project Browser, right-click the new schedule, and choose **Properties** from the context-sensitive menu.



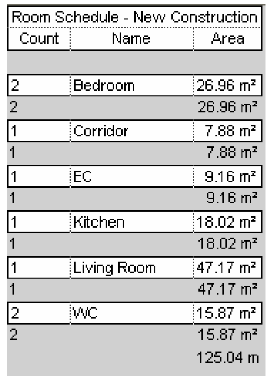
17. Change the **Phase** parameter to **New Construction**.

18. Click **OK** to close the window.





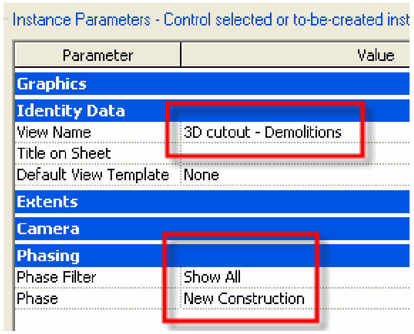
Room Schedule - New Construction		
Count	Name	Area
1	Corridor	2.16 m²
1		2.16 m²
1	Entrance	7.22 m²
1		7.22 m²
1	Hallway	9.85 m²
1		9.85 m²
1	Meeting Room	32.76 m²
1		32.76 m²
4	Office	59.37 m²
4		59.37 m²
1	Service	2.41 m²
1		2.41 m²
1	WC	9.16 m²
1		9.16 m²
		122.94 m



Room Schedule - New Construction		
Count	Name	Area
2	Bedroom	26.96 m²
2		26.96 m²
1	Corridor	7.88 m²
1		7.88 m²
1	EC	9.16 m²
1		9.16 m²
1	Kitchen	18.02 m²
1		18.02 m²
1	Living Room	47.17 m²
1		47.17 m²
2	WC	15.87 m²
2		15.87 m²
		125.04 m

19. In the Project Browser duplicate the 3D view: **3D Cutout – Existing** and rename the new view **3D Cutout – Demolitions**.

20. Open the newly created 3D View properties and change the **Phase** to **New Construction**.

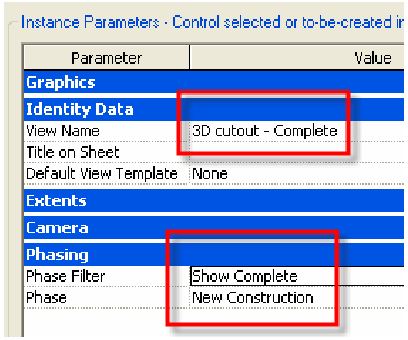


21. Click **OK** to close the dialog box.

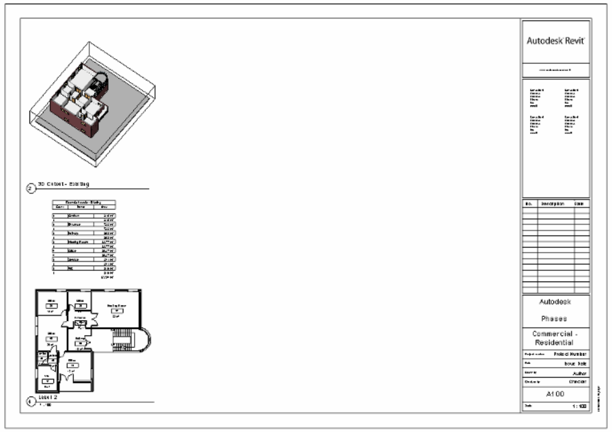
22. Duplicate this 3D view and name the new view: **3D Cutout – Complete**.

23. Open the newly created view's properties and change the **Phase Filter** to **Show Complete**.

24. Click **OK** to close the dialog box.



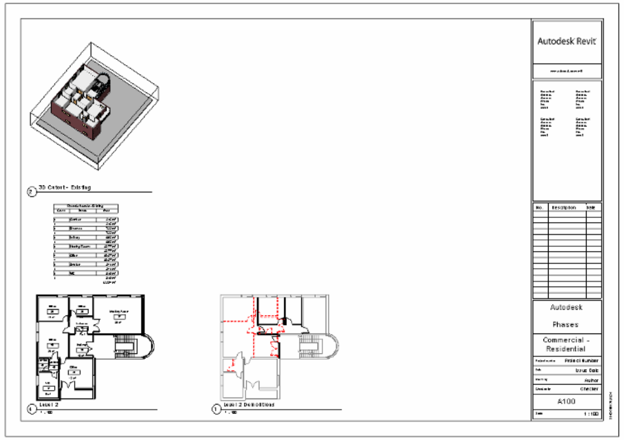
25. Open the Sheet view: **A100 - Commercial – Residential**.



This sheet already has the original views placed on the sheet:

- 3D Existing Cropped
- Existing Room Schedule
- Level 2 (Floor Plan)

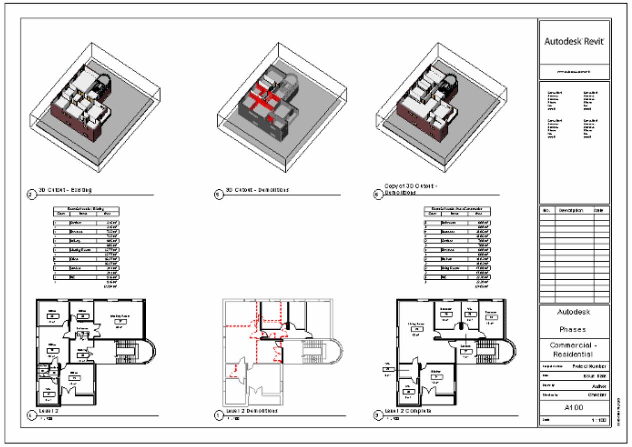
26. Drag the view: **Level 2 Demolitions** on the sheet and position it in the middle, as shown in image.



27. Drag on the sheet the views:

    a. Level 2 – Complete
    b. 3D Cutout – Demolitions
    c. 3D Cutout – Complete
    d. Room Schedule – New Construction

    Position them as shown in image.



Unit 20

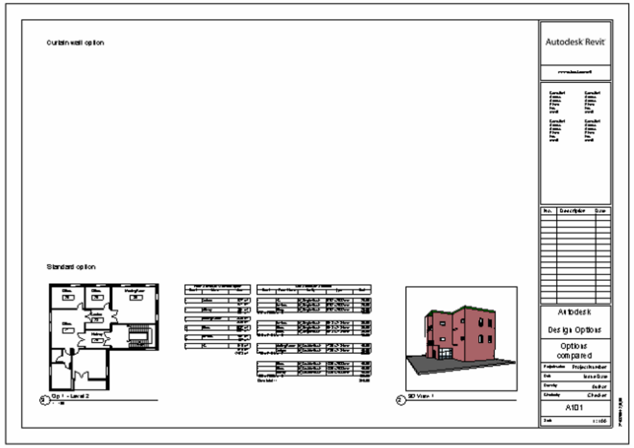
Theory: Variation

Autodesk Revit Building: Options

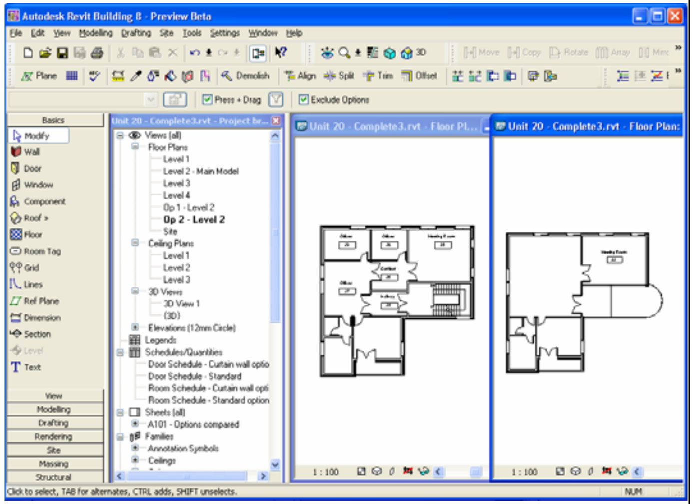
This unit guides you through the powerful Design Options feature. You start using a file that already contains a couple of design options.

1. Open **File Unit 20 – Start**. This file contains an option set with two different design options.

2. Open **Floor Plan: Op 2 Level 2**.



3. Close hidden windows. Open **Floor Plan Op 1 – Level 2** and **tile windows** to display both options.



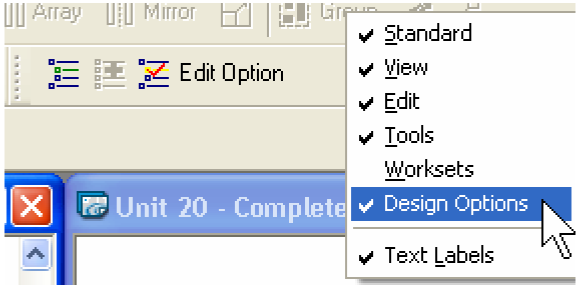
Note how tiling windows lets you visualize both, or more, options in different views.

Both views represent the 2nd floor of the building. All components are held in the building model. However, the interior walls of the floor, along with the stair and east wall are held in Design Options.

When the project contains Design Options, the Options Bar displays a check box to allow selection of components that are part of the option set:

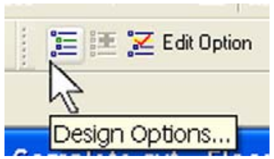
View the Options

4. Right-click the toolbar and select the Design Options toolbar.

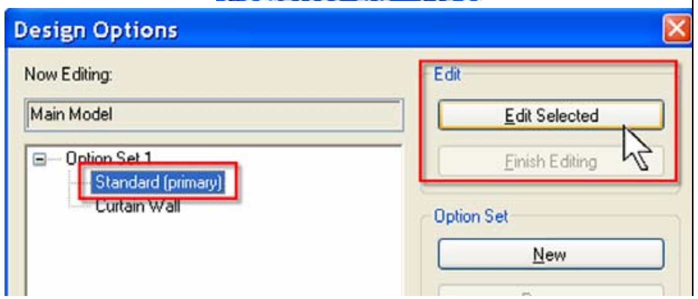


In this file you have only one option set, but you can have as many as you want. Normally, an option set is a specific part of a building where you want to try different design alternatives. An option set can contain as many options as you want.

5. Click the Design Options tool to open the Design Options dialog box.



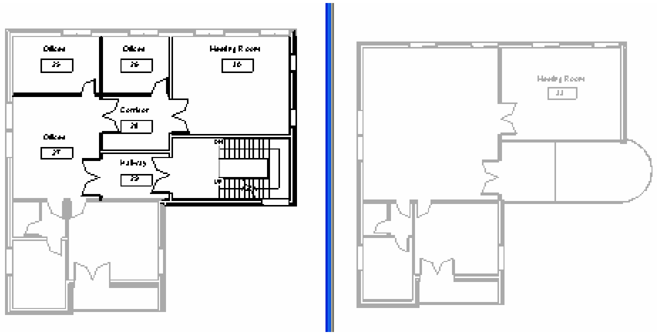
6. Select **Option Set 1 - Standard (Primary)** and click **Edit Selected**.



The Now Editing window displays the active, edited option.

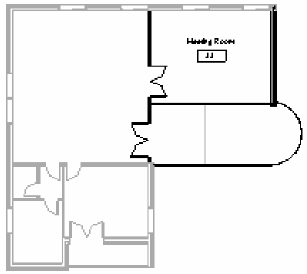
When you edit an option, all components that are not part of the option are displayed in gray.

7. Do not dismiss the Design Options dialog box yet.



8. In Design Options dialog box:

- Click **Finish Editing**.
- Click **Curtain Wall**.
- Click **Edit Selected**.



With two options, as in this case you have three sets of objects:

- Those in the main model
- Those in sets unique to each of the options

When you are editing an option, you can see and refer to objects in the main model, but by default you cannot edit them.

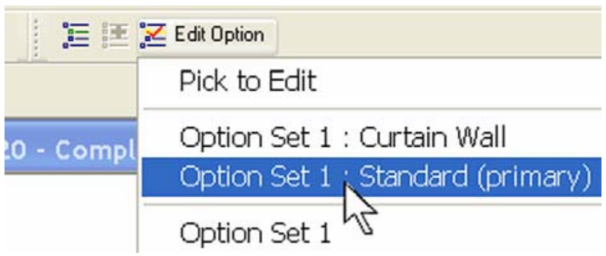
9. While still in Edit Curtain Wall option mode, click **Close** in the Design Options dialog box.

The Options Bar displays a check box that allows selection of components that belong to the main model (not to an option set).

10. Click the **Edit Options Tool** button to end editing of the curtain wall option.

You are returned to standard editing mode with neither option open.

11. Click the **Edit Options Tool** button and from the drop-down menu, select **Options Set 1: Standard (Primary)**.

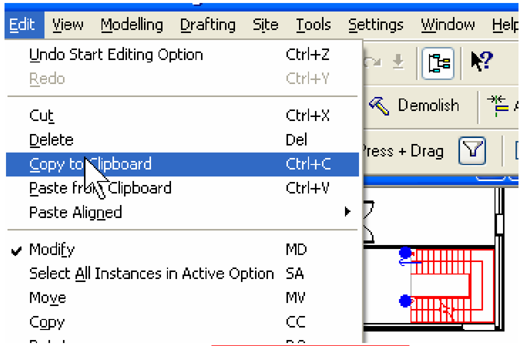


This shortcut bypasses the Design Options dialog box.
This tool is cyclical. If you click it again, you exit the edit option mode (don't do this yet).

Modify Options

12. While editing the Standard Option, select the **stairway** on the east end of the building.

13. From the **Edit** menu, choose **Copy to Clipboard**.



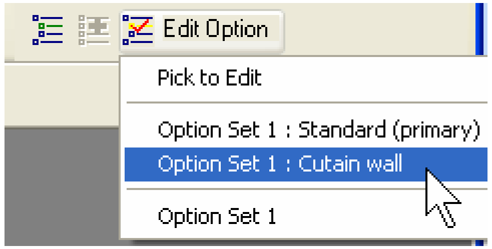
Copy to Clipboard and Paste Aligned (Same Place) constitute an easy way to replicate a situation among different options.

You can also duplicate an option within an option set by selecting it in the Design Options dialog box and clicking Duplicate.

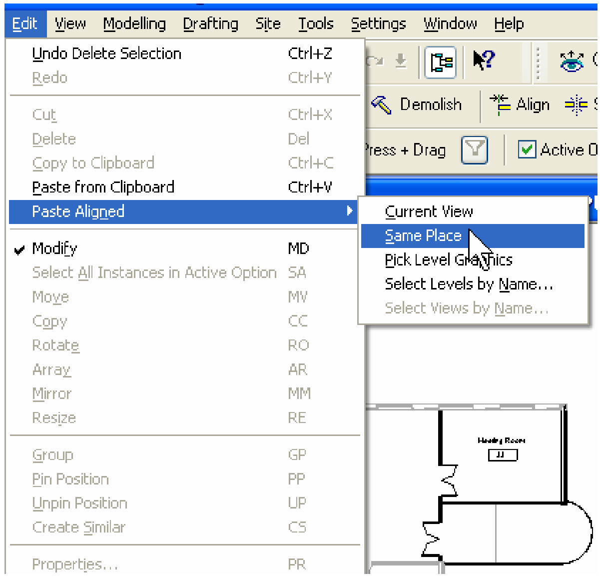
14. On the Design Option toolbar, click **Edit Option** to finish editing the option.

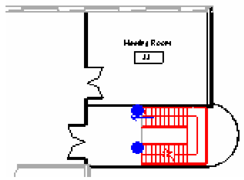
The Design Option toolbar allows for quick selection of the available design options.

15. Click the **Edit Option** button again, and from the drop-down list select **Option Set 1: Curtain Wall**.

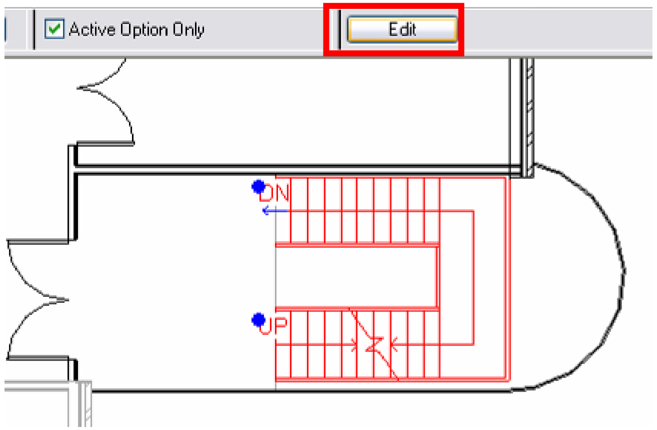


16. From the **Edit** menu, choose **Paste Aligned>Same Place**.



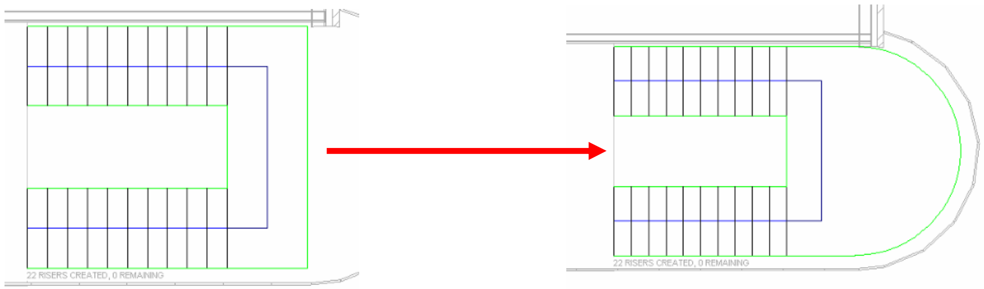


17. Select the stair, and on the Options Bar click **Edit**.



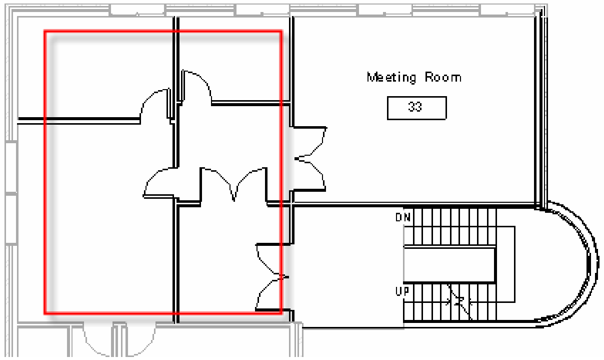
When editing stairs, you enter sketch mode.

18. Reshape the landing **boundary** of the stair as shown in image. On the Design Bar, click **Finish Sketch**.

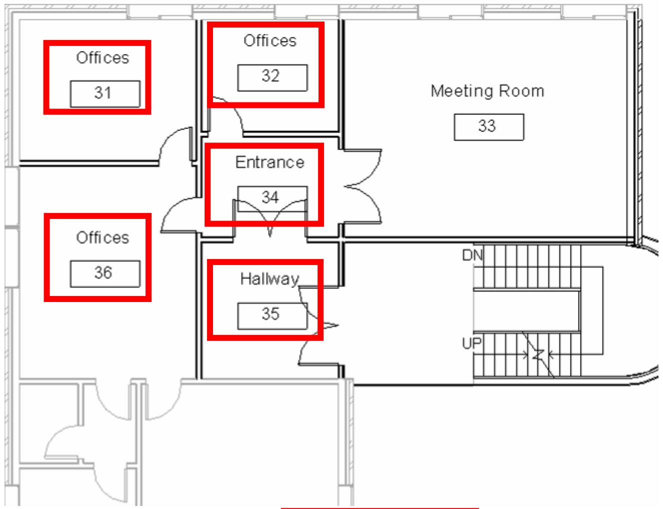


When working in the stair sketch mode, click the Boundary button on the Design Bar to draw the boundary lines. Select the arc line template. Draw the line, and click Finish Sketch.

19. Add walls and doors to complete the design as shown in image.



20. On the Basics Design Bar click **Room**. Add room to all rooms in the option. After placing the tags, rename the rooms as shown in image.



Make sure you are still editing the option before adding the rooms if you want the rooms to be part of the option. You might get an error if you have tagged the same rooms when in normal mode (not in option editing).

21. On the Design Option toolbar, click the **Edit Option** button to finish editing the option.

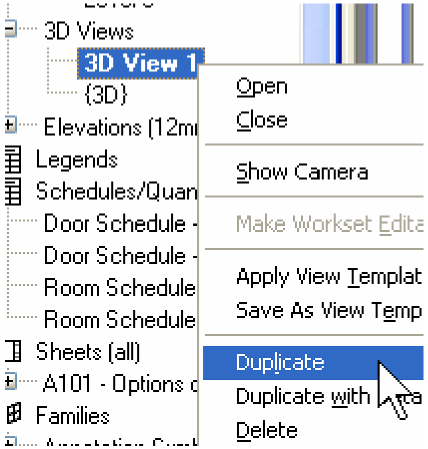
Assign an Option to a View

22. Open **3D View 1**.

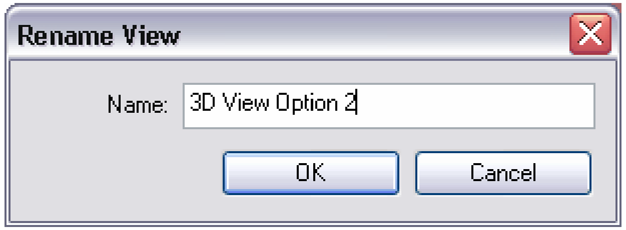
You have been working in two views that are both views of the 2nd level. The only difference between these is a setting in the view properties assigning one option or the other.

By default, a view shows the option marked (Primary), in this case the standard option.

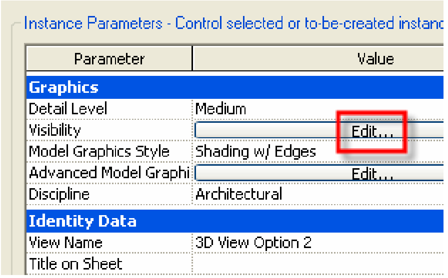
23. In the Project Browser, right-click the 3D view 1 and choose **Duplicate**.



24. Rename the view **3D View - Option 2**.



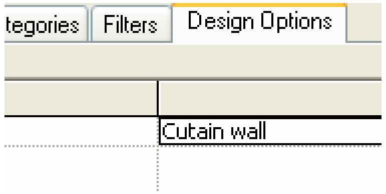
25. Open the **View Properties** dialog box by right-clicking the view in the Project Browser and choosing **Properties**. On the **Visibility** line, click the **Edit** button.



When there are Design Options in the project file, Autodesk Revit Building adds a new tab in the visibility settings of the views.

You can display any option in any desired view: plans, elevations, sections, and so forth.

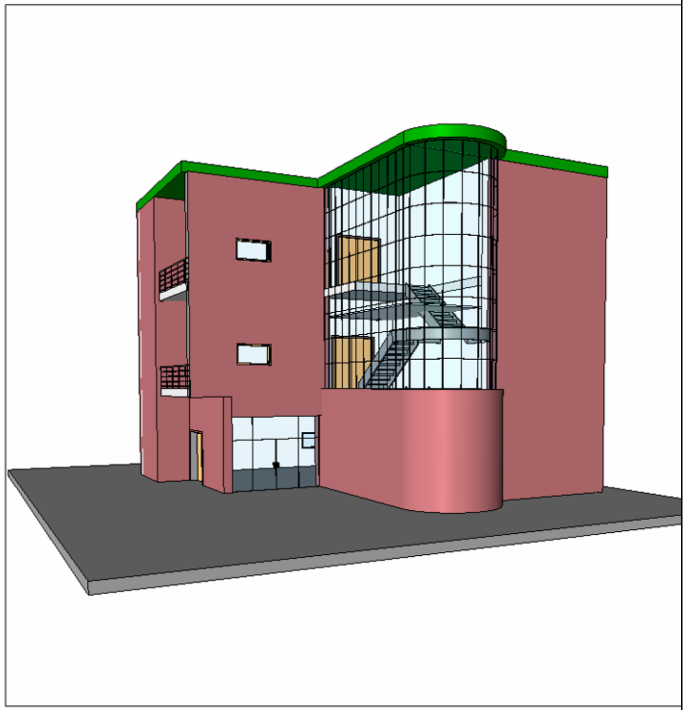
26. On the **Design Options tab**, select **Curtain Wall** from the drop-down menu under Option Set 1.



The drop-down menu displays the available options for the option set.

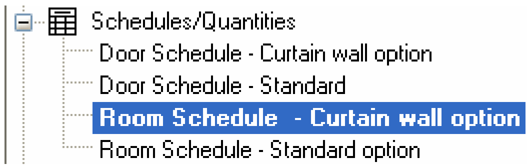
When the value is set to Automatic, the view displays the primary option but switches to show the one you are modifying when in edit mode.

27. Click **OK** to close the dialog boxes and see the changes.



Assign an Option to a Schedule

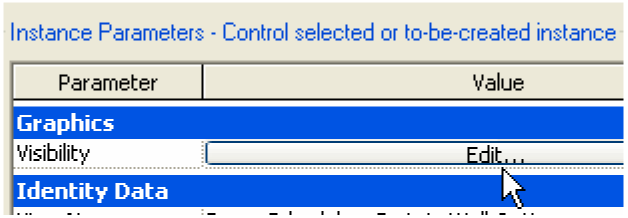
28. In the Project Browser go to the **Schedules/Quantities** category and right-click **Room Schedule – Standard Option>Duplicate**.
29. Rename the new schedule view to **Room Schedule - Curtain Wall Option**.



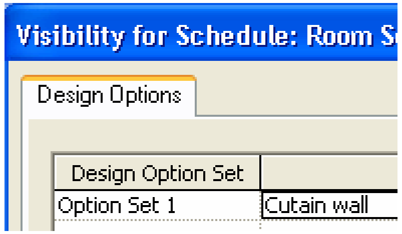
30. Right-click the **Room Schedule – Curtain Wall** option again, and choose **Properties**.

Schedules are views as plans and sections. They can display the desired design option to evaluate the different quantities or costs according to the option displayed.

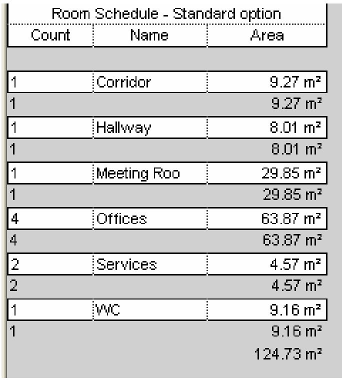
31. Click the Visibility **Edit** button.



32. From the drop-down menu, select **Curtain Wall**. Click **OK** to close the dialog box.

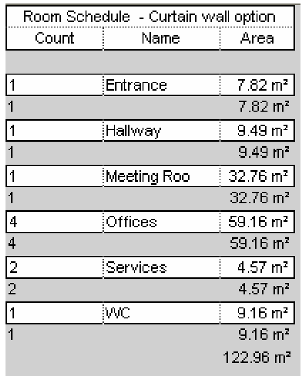


Although access to this component is a bit different for the schedule than for the 3D view, the theory is the same. A schedule is just a text view of the building model.



Room Schedule - Standard option		
Count	Name	Area
1	Corridor	9.27 m²
1		9.27 m²
1	Hallway	8.01 m²
1		8.01 m²
1	Meeting Roo	29.85 m²
1		29.85 m²
4	Offices	63.87 m²
4		63.87 m²
2	Services	4.57 m²
2		4.57 m²
1	WC	9.16 m²
1		9.16 m²
		124.73 m²

Predesign options set shows the entire model along with the standard option (primary) rooms

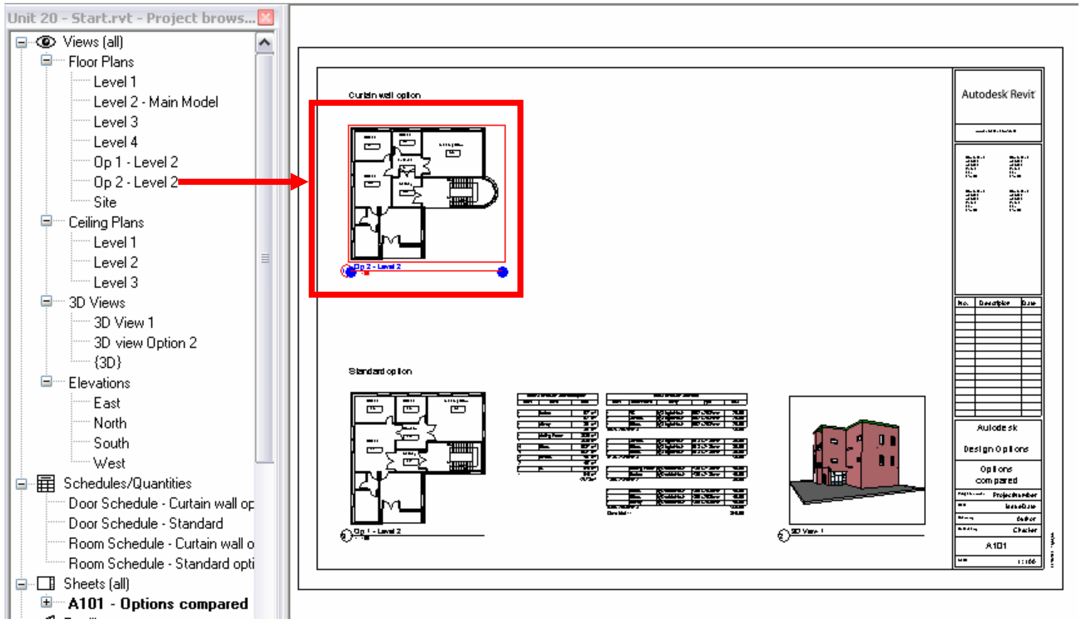


Room Schedule - Curtain wall option		
Count	Name	Area
1	Entrance	7.82 m²
1		7.82 m²
1	Hallway	9.49 m²
1		9.49 m²
1	Meeting Roo	32.76 m²
1		32.76 m²
4	Offices	59.16 m²
4		59.16 m²
2	Services	4.57 m²
2		4.57 m²
1	WC	9.16 m²
1		9.16 m²
		122.96 m²

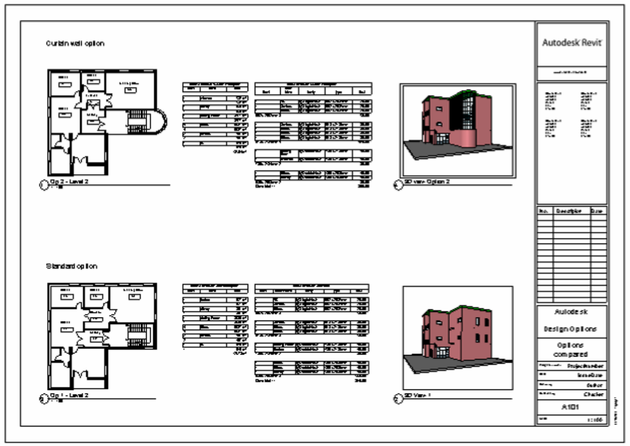
After you assign the option, it lists only those rooms that have been tagged in that option. This is essential because one option may call a room an office, and in another office a similar area may be a storage closet.

Place Views of the Options on a Sheet

33. In the Project Browser, double-click the sheet **A101 – Options Compared**.
34. In the Project Browser, drag **Floor Plan: Op 2 Level 2** onto the sheet as shown in the image.



35. Place the following views on the sheet, as shown in image: **3D view Option 2**, **Door Schedule Curtain Wall Option**, and **Room Schedule – Curtain Wall Option**.



You have to turn on the crop region of the 3D view Option 2 and adjust the boundaries of the crop region to fit on the sheet.

Change Primary Option and Accept Primary

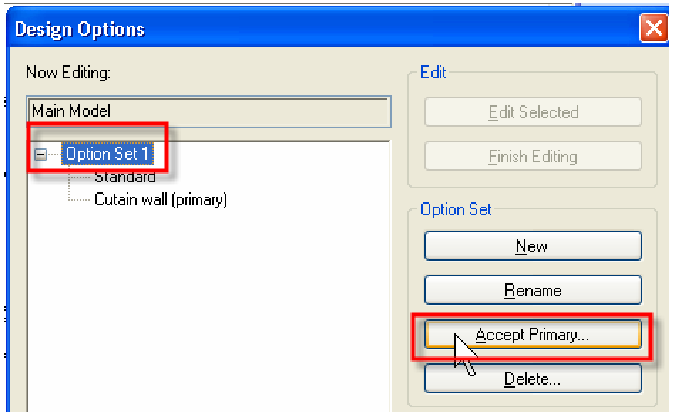
36. Open Floor Plan **Level 2 – Main Model**.
37. On the Design Option toolbar, click the **Design Option** button.

38. Choose the **Curtain Wall** option, and click **Make Primary**. You might get a warning, but ignore it.

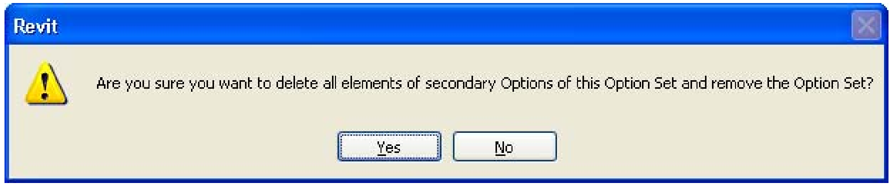
A warning may appear when accepting the primary option, depending on how walls are joined.

You can normally ignore these warnings and proceed with the next step.

39. Choose **Option Set 1**.
40. Click **Accept Primary**.

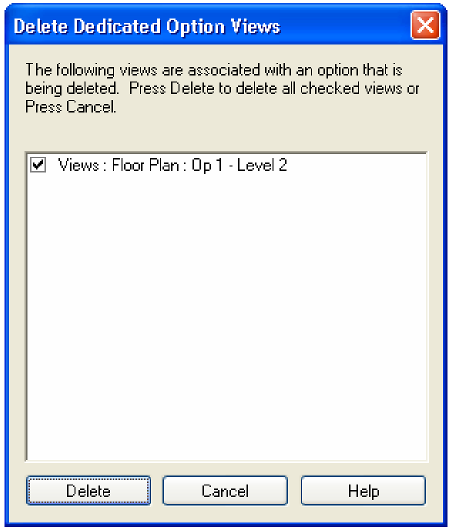


41. Click **Yes** when the dialog box opens.



Because you are finished with the options process, accepting the primary option deletes all the elements that are stored in Option Set 1: Standard option.

42. Click **Delete** when the dialog box opens.



Because you are deleting all the objects that are shown in these views, deleting the views makes sense.

The other views, such as 3D View 1, as well as the schedules, are set to display, which automatically displays the primary option. These views are *not* deleted when you accept the primary option.

43. The Design Options dialog box is now empty.

After clicking the Accept Primary button, all options disappear and the components in the primary option become part of the main model.

Note that the sheet now displays the same information twice and the views display the same model.